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CONTRIBUTIONS TO OUR KNOWLEDGE OF AMERICAN
CARBONIFEROUS FLORAS¹

I. SCLEROPTERIS, GEN. NOV., MESOXYLON AND AMYELON

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The occurrence in America of the petrifications known as coal-balls has been known for many years and in itself needs no review. It is, however, still rather generally accepted that American coal-balls are by no means the equal of the renowned English specimens that have yielded such a wealth of information concerning the flora of Carboniferous times. Much of the American material is highly pyritized, and although pyrite does not necessarily render the petrifications worthless it is not the most desirable preserving mineral. Pyritized material from the English mines is by no means unknown, while many of the American specimens are quite free from pyrite or contain but insignificant quantities and the plants contained in the coal-balls often exist in an exquisitely fine state of preservation.

It has been my privilege to study rather carefully most of the great English collections of petrified Carboniferous plants, and from a comparison of those with some hundreds of Illinois specimens that have recently come into my laboratory there is no doubt that the better ones are equally as well preserved as the English. The commonly encountered "open pit" method of mining in our central states is making huge quantities of material available, and much may be expected of the ensuing studies on American paleobotany during the coming years. It must be remembered, moreover,

¹ A study financed in part by a grant from the Penrose Fund of the American Philosophical Society.

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that the outstanding English collections and the slides dispensed by professional petrologists represent the choice selections of nearly a century of labor, while almost nothing has been done with American coal-balls until a very few years ago. It is safe to assert that when our own flora is better known it will not suffer by comparison.

Although a considerable number of species have already been reported from the petrifications of the midwestern states (Darrah, '41), few comprehensive studies have been undertaken. It is planned to present here, and in the following parts of this series, descriptions of the plants composing the coal-ball flora, chiefly of southern Illinois. As it is not possible to present the results of such a study in phylogenetic order without undue delay, they will appear as adequate material of the genera is collected and studied.

All of the specimens on which the present paper is based were collected by the author and his students from the open-pit Pyramid Mine of the Binkley Coal Co., located about three miles south of Pinckneyville, Perry County, Illinois. I wish to express my appreciation for the very generous assistance and cooperation extended to me during many visits by officials and employees of that mine.

The petrifications are abundant, although, as might be expected, they are by no means uniformly distributed through the coal. One may chance upon a "nest" of half a ton or more or wander along the seam for a mile without encountering any. The better coal-balls are usually found near the top of the seam, sometimes a foot or so below the surface, but more often than not in sheet-like aggregations, their tops flush with the surface of the coal. They are easily detected when the latter is exposed and slightly weathered. The mineral content of these more or less unit aggregations seems to be quite constant, and in many cases they are very nearly free of pyrite. Thus it is a rule that when one or two good specimens are picked up, dozens of others are near at hand.

The better coal-balls lend themselves readily to the preparation of satisfactory nitrocellulose peels, although it has been found necessary in some instances to use them in conjunction with ground sections.

Arborescent Lycopod stem remains constitute the dominant floral feature of our collections. Associated with them are *Lepidophyllum*, *Stigmaria* and *Lepidocarpon*. A consideration of the stems and leaves will be presented at a later date, while a description of a remarkably well-preserved gametophyte and the microsporangiate

cones of *Lepidocarpon* constitutes the second contribution of this series (see p. 19). Stems and roots of *Sphenophyllum* are well represented and fructifications probably referable to *Scolecopteris* occur in many specimens. *Heterangium* is also present. Stems and roots of *Mesoxylon* are common, and these, together with a new genus of coenopterid ferns, will be considered in the following pages.

***Scleropteris illinoiensis* Andrews, gen. et sp. nov.**

General Anatomy and Procedure.—

Our knowledge of this pteridophyte is derived from a small portion of a branched stem which, although fragmentary, is excellently preserved. Since but one specimen has been encountered in some hundreds of coal-balls, it seems desirable to describe it without further delay. As will be pointed out in the following pages, *Scleropteris* resembles in some respects *Botrychioxylon* and *Zygopteris* but certain highly distinctive features of the cortex, as well as the tracheidal pitting, set it apart from these two genera (or one, as Sahni ('32) has shown may be the case).

The specimen was about 6 cm. long and branched twice. Prior to the first division, an equal dichotomy, the stem measured 1.3 cm. in diameter. Shortly after the dichotomy of the stele the stem became somewhat flattened, measuring 1×2 cm., and the two resultant branches each measured 1 cm. in diameter. These figures are necessarily approximate due to some slight crushing and distortion.

The most distinctive feature of the stem lies in the sclerotic nests scattered through the broad cortex. The stele consists of a mixed primary body surrounded by more or less radially arranged tracheids presumably of secondary origin. Adventitious roots are numerous.

The specimen was cut into three slices perpendicular to the long axis of the stem. The central section was used for a series of longitudinal peel preparations, the other two for transverse sections. Unfortunately, the initial saw cut passed directly through the point of dichotomy of the stele.

Preparations made by the nitrocellulose peel technique proved very satisfactory. In fact, in this particular case they were superior both for study and photographic purposes to ground sections. It was found that by photographing the peels unmounted, rough side down, against a black background, excessive reflection was reduced and much finer detail was obtained than when the peels were mounted in balsam.

The Stele.—

Figure 2 of pl. 1 represents a transverse section of the entire stem prior to dichotomy, while fig. 1 shows it shortly above the division of the stele. It may be noted that the dichotomy is equal, both branches (pl. 1, fig. 1, *st*₁, *st*₂) being approximately the same size. The stele itself, taken from a point about 1 mm. above the section represented in fig. 2, is shown more highly enlarged in fig. 3. At this point, which is immediately prior to dichotomy, it is oval-shaped but is otherwise nearly circular in cross-section (pl. 3, fig. 11). There the stele measures 2 mm. \times 3.5 mm., while after division the resultant branches are approximately 1.3 mm. in diameter.

The central part of the stele is mixed, being composed of small tracheids scattered through the parenchyma cells. The latter may be isodiametric but for the most part are vertically elongated, being 2-4 times as long as broad. It is not possible to distinguish definitely protoxylem elements in transverse section. In median longitudinal sections, however, small scalariform tracheids may be observed near the periphery of this primary mass (pl. 2, fig. 7, *px*). It would thus seem that the primary wood was mostly centripetal, as is probably the case in *Botrychioxylon paradoxum*, but this point is not without an element of doubt in both species.

Around the mixed primary xylem there is a zone of larger tracheids, for the most part radially arranged and presumably secondary in origin. These are uniformly pitted on both radial and tangential walls. Some of the small tracheids located near the inner margin are scalariform but all of the larger ones possess multi-seriate bordered pits although they may be slightly elongated horizontally (pl. 2, fig. 7). With reference to the pitting of *B. paradoxum*, Scott ('12) writes: "The large tracheids of the secondary wood have scalariform markings, the bars being often short, so that there are two or three series on the same wall." [p. 376]. His fig. 21, pl. 41, bears out this description. The pits are much less closely compacted in *Scleropteris*, and although there are transitions between scalariform and nearly circular bordered pits the latter are distinctly predominant.

Since no tangential sections of *B. paradoxum* were prepared, the presence of wood rays was left in question. Scott writes: "It is doubtful whether true medullary rays are present; if so they must be very few in number. Transverse sections afford no decisive proof of their existence." [p. 375]. It is likewise difficult to discern rays

with certainty in the cross-sections of *Scleropteris* but serial longitudinal sections reveal their presence. A tangential section from near the outer margin of the secondary wood (pl. 3, fig. 12) shows uniseriate rays of great height.

The secondary wood is not extensive, varying from 5 to 9 cells wide. The cells are, for the most part, radially arranged and occasional evidence of cambial activity at the periphery leaves little doubt as to its true secondary origin.¹

Although the tissues immediately outside the xylem are not as well preserved, in certain sections there may be observed a narrow phloem, a pericycle two cells wide and what appears to be an endodermis the cells of which are filled with a very dark substance. The endodermis is, however, not readily distinguishable in most sections, as might be expected where an appreciable amount of secondary growth has taken place.

The Cortex.—

The most prominent feature of the stem lies in the abundant sclerotic nests scattered through the cortex (figs. 1, 5, 6 of pls. 1-2). Although rather irregularly shaped they appear more or less isodiametric in cross-section and slightly elongated longitudinally (figs. 5, 6). The sclereids composing the nests are very thick-walled, in some the lumen being almost lacking. Like the nests as a whole, they are slightly elongated longitudinally.

The outer parenchymatous cortical cells contain an abundance of branching fungal filaments. Although they may compose the mycelium of a decay organism, their aggregation within the cells suggests a mycorrhizal relationship.²

¹ It is evident from recent anatomical studies that the distinction between primary and secondary vascular tissues is not as sharp a one as was once supposed, and it is possible that these radially arranged tracheids have had their origin from a multiple ("primitive") cambial layer rather than a single row of meristematic cells.

² *Mycorrhizae and the origin of roots:* The presence of mycelium in the tissues of fossil plants is not uncommon, and it occurred to me some few years ago that there might be a deeper lying significance to this association than most authors realized. The idea, and I do not claim absolute priority although I know of no published formulation of it, seems worthy of some thought. Briefly stated, it seems possible that mycorrhizae or a mycorrhizal-like association were a deciding factor in the establishment of the higher land plants and that root hairs and rhizoids are the result of later specialization in the higher vascular plants and the lower vascular plants and bryophytes respectively.

It is supposed that mycorrhizal associations existed prior to the evolution of the normal absorbing organs of these plants and that as the aquatic ancestors migrated landward the mycorrhizae made possible this new habitat; and as these newly arrived land plants

The cells of the outermost cortical layers and epidermis are arranged in peculiar mounds which seem to represent the basal portions of emergences (pl. 1, fig. 4). Whatever was the nature of such emergences is not known. Most of them terminate in a flat top as shown in fig. 4. That they do represent the basal part of a superficial appendage seems certain as their remnants are present in some of the sections and none show evidence of having possessed vascular tissue.

Petioles are lacking in the single available specimen. It was thought at first that the small branch shown at the right of fig. 5 might be a petiole but the serial longitudinal peels reveal no positive evidence of a leaf gap at its junction with the main stem stele. The specimen is, then, either a fragment of a plant bearing rather widely separated nodes or it is one in which there is no distinct segregation of the shoot system into stems and leaves as they typically occur in more recent groups.

Roots.—

Adventitious roots are numerous throughout the specimen. Three may be seen in various stages of departure from the stele in pl. 1, fig. 3. The passage of the root stele through the cortex is irregular but in most cases it appears to be upward at an angle of about 30° with the stem stele. It is not possible to determine for certain the number of protoxylems. There seems to have been some secondary xylem, as well as cork cambial activity, and the cortex is comparatively broad.

Diagnosis.—

A dichotomously branching stem 1–1.3 cm. in diameter; stele consisting of a central mixed primary region, probably centripetal in development, surrounded by a zone of radially arranged tracheids

became better adapted to their new habitat they developed rhizoids or root hairs and roots which gradually replaced the fungus. There are a number of points that lend support to such a hypothesis. Roots are lacking in the earliest land plants but rhizoids are present and in certain cases fungal associations that may be mycorrhizae; roots are not strongly developed in the higher vascular cryptogams as a whole; in certain seed plants it is well known that germination of the seeds and early growth of the young seedling is difficult or impossible without mycorrhizae.

The possibility is, of course, clearly recognized that the rhizoid-like structures present in the algae may have given rise directly, in all instances, to the corresponding structures in early land plants. This concept of the part that mycorrhizae may have played is presented for what it may be worth.

bearing multiseriate bordered pits on radial and tangential walls; prominent sclerotic nests scattered through cortex.

Affinities of Scleropteris.—

As far as stelar structure is concerned, the affinities of this genus appear to lie with the zygopterid ferns, with which it agrees in the division of the stele into a central mixed pith and a peripheral region of comparatively large tracheids. In both *Ankyropteris* and *Zygopteris* a weak development of secondary wood has been reported. Compared to these two, the tracheids of *Scleropteris* seem to be much more regularly arranged and more distinctly secondary. Of the described species of *Ankyropteris* the closest comparison is with *A. corrugata* (Holden, '30) but in that species the tracheids are typically scalariform, quite in contrast to the multiseriate and nearly circular pits of *Scleropteris*. The closely compacted leaf bases of *Zygopteris* and the branching of the stem in *Scleropteris* present contrasting characters which sharply separate these two genera.

The cortical sclerotic nests of *Scleropteris* constitute the most distinctive feature of the fossil and set it apart from any other fern referred to the Coenopteridineae (classification of Hirmer, '27). These structures are of interest not only for their diagnostic value but because they suggest these possible affinities with the pteridosperms. First, one of the most prominent features of that group is the dictyoxylon cortex so strikingly displayed in *Lyginopteris*. It seems evident that this tissue must have had its origin in a less highly organized arrangement of parenchymatous and sclerotic or fibrous cells, and the scattered, slightly vertically elongate nests of *Scleropteris* may represent a step in that direction. Second, the radial arrangement of the tracheids indicating weak cambial activity points in a gymnospermous direction.

Mesoxylon.—

Judging from the frequency of occurrence of Cordaitan stems and roots in the Pyramid Mine petrifications, this group was well represented in the Carboniferous Lycopod forests of southern Illinois. The stem remains described below are referable to *Mesoxylon*, and although in themselves they present only such features as are already known in the five English species, it has been possible to demonstrate that roots of the *Amyelon* type, long considered to be of Cordaitan affinities on the basis of association, actually occur in organic connection with *Mesoxylon*.

The stems are fairly well preserved and the roots exquisitely so. It has not been possible, however, to work out satisfactorily the structure and course of the leaf traces or leaf bases, and as these have been used chiefly in delimiting species it seems advisable to assign a new specific name to our specimen. The most significant point in the present discussion lies not in the recording of another species of *Mesoxylon* based on trivial or even negative characters but in the presentation of conclusive proof that *Amyelon* is the root of a Cordaitean stem.

The stems attain a diameter of little more than 2 cm. including extra-stelar tissues. The pith in the larger specimens averages about 14 mm. and is typically chambered. The peripheral region consists of large parenchymatous cells about 105 μ in diameter by 60 μ high which are arranged in rather regular vertical rows.

Surrounding the pith are prominent masses of primary wood. These are sufficiently well preserved to state with reasonable certainty that the protoxylem is mesarch (pl. 3, fig. 10). The latter seems to be the only distinctive generic character of *Mesoxylon* segregating it from Cordaites, and in view of the otherwise close similarity between the two the validity of its use as a generic character must be looked upon with some doubt. In a previous paper ('40) I have dealt with the variability in the primary body of the pteridosperms and other groups and have pointed out that the position of the protoxylem must be used with reservation as a taxonomic character.

The tracheids of the secondary wood range in cross-section from $15 \times 21 \mu$ to $21 \times 30 \mu$, the tangential dimensions being somewhat greater in most cells. As is usual in Cordaitean stems, there is a broad pitting transition zone bordering the pith, the innermost tracheids being spirally thickened. These are followed through a radial distance of about 10 cells by scalariform, reticulate, and pitted cells. The latter are not well preserved, and it is not possible to determine the number of rows of pits per cell. The rays are uniseriate and low, ranging from 1 to 3 cells high (pl. 4, fig. 17) with an occasional ray 4 or 5 cells high.

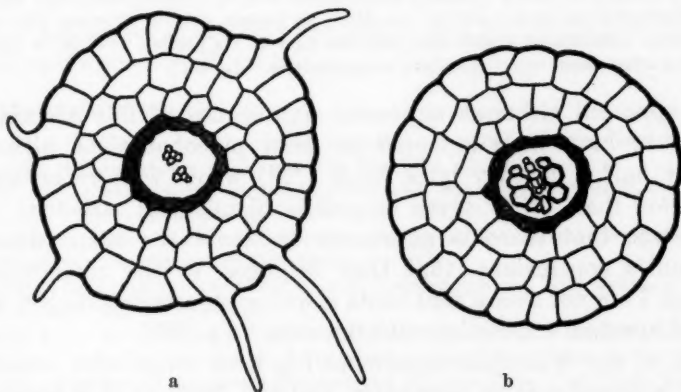
Roots.—

Well-preserved roots belonging to the form genus *Amyelon* and associated with Cordaitean stem remains have long been known from the Carboniferous of Europe and have more recently been reported in coal-balls from Iowa (Wilson and Johnston, '40). The

specimens in our collections from the Pyramid Mine consist of minute rootlets bearing well-preserved hairs up to larger roots 3 mm. in diameter.

There is some question as to the identity of the smallest rootlets, but their association with the older typical specimens of *Amyelon* strongly suggests that they belong to that genus.

In the youngest roots (text-fig. 1a) the diarch primary xylem consisting of only 8 or 10 cells, may be observed in the center. All of the roots, young or old, studied thus far are diarch, and the development of the metaxylem is, of course, entirely centripetal. The phloem is not preserved but immediately outside the position it ap-



Text-fig. 1. Rootlets, probably of *Mesozylon*. In *a* there may be observed the large epidermal cells with root hairs, two layers of cortical cells, the dark endodermis and the diarch primary xylem. In *b* a few secondary xylem cells are present. WCB31F.T5. $\times 84$.

parently occupied is an endodermis the cells of which are filled with a dense brown substance (text-fig. 1, fig. 8). Beyond this is a cortex of larger, thin-walled cells slightly elongated longitudinally. The cells of the epidermis are somewhat larger and thicker-walled.

One of the most interesting features of these rootlets is the beautiful preservation of the root hairs. These may be seen in pl. 3, fig. 8 and at higher magnification in fig. 9. They are clearly typical root hairs, being outgrowths of the epidermis and composed of but a single cell. Most of the young roots show a trace of secondary xylem starting to form (text-fig. 1b).

In all the older roots the secondary wood is strongly developed (pl. 4, fig. 16). This is followed by a narrow band of phloem and a

cortex of rather large cells many of which appear to be resinous.

The development of periderm started early and all except the smallest roots possess some. The origin of this cork cambial activity was not as deep seated as described by Osborne ('09) for the English specimens, since an appreciable thickness of cortex remains in the older roots. As far as this feature is concerned, the roots described here seem to be intermediate between the English ones and those described by Renault ('79) from France.

The question of the natural affinities of the roots may now be considered. In 1879 Renault noted their association with Cordaitan stems and wrote:

"Au milieu des mêmes fragments silicifiés que renferment les rameaux et les feuilles de Cordaitales on trouve souvent des débris de racines, dont la structure offre une analogie suffisamment grande avec celle des tiges de ces plantes, pour qu'on puisse les regarder comme ayant appartenu à ces dernières." [p. 294].

The apparent although unproven significance of this association seems to have been accepted by most paleobotanists, although nearly half a century later Scott ('23) wrote with reference to *Amyelon* that, "they agree so well in histological structure with the stem, that there is no reason to doubt the correctness of Renault's conclusions, that they belonged to the same plants, though I am not aware that roots showing structure have yet been found in actual connection with the stem." [p. 286].

One of our *Mesoxylon* specimens has been found with *Amyelon* roots in actual organic connection, and figs. 13-14 of pl. 4 represent three successive ground sections through part of the stem. In the upper right of fig. 13 a noticeable bulge appears in the periphery; in the next section (fig. 14) the departing adventitious root is very prominent while in the next (fig. 15) it is almost clear of the stem. Fortunately the root was preserved in such a position that immediately after departing from the stem it lay parallel to the latter. Thus, fig. 15 shows the outer part of the root in transverse section and in the next section (fig. 16) the root appears quite separate from the stem and in perfect transverse section. At the left of fig. 15 another root may be seen departing from the stem.

The American and European specimens of *Amyelon* are all so nearly alike that it can now be certainly asserted that they belong to Cordaitan stems. As is usual with roots, their anatomy is more stereotyped than the other vegetative organs, and there seem to be no known dependable characters that make possible the delimitation

of distinct species of *Amyelon*. The chief variations in the roots are size, number of protoxylem poles and relative origin of the periderm with reference to the cortex, and none of these (with the possible exception of the last) is sufficient for specific segregation.

Mesoxylon Nauertianum Andrews, sp. nov.

Diagnosis.—

Stems 2 cm. or more in diameter; pith large and chambered; peripheral cells arranged in vertical rows; protoxylem mesarch; secondary xylem tracheids averaging $18 \times 25 \mu$ in cross-section, pitting transition broad, rays uniseriate and mostly 1–3 cells high; roots in organic connection with the stem of the *Amyelon* type.

The species is named in recognition of Mr. N. H. Nauert whose willing assistance in the field and ability as a technician has greatly facilitated my coal-ball studies.

Literature cited.—

- Andrews, H. N. (1940). On the stelar anatomy of the pteridosperms, with particular reference to the secondary wood. *Ann. Mo. Bot. Gard.* 27: 51–118.
- Darrah, W. C. (1941). Studies of American coal balls. *Am. Jour. Sci.* 238: 33–53.
- Hirmer, M. (1927). *Handbuch der Paläobotanik*. Berlin.
- Holden, H. S. (1930). On the structure and affinities of *Ankyropteris corrugata*. *Phil. Trans. Roy. Soc. London, B* 218: 79–114.
- Osborne, T. G. B. (1909). The lateral roots of *Amyelon radicans*, Will., and their mycorrhiza. *Ann. Bot.* 23: 603–611.
- Renault, B. (1879). *Structure comparée de quelques tiges de la flore Carbonifère*. Paris.
- Sahni, B. (1932). On the structure of *Zygopteris primaria* (Cotta) and on the relations between the genera *Zygopteris*, *Etapteris* and *Botrychioxylon*. *Phil. Trans. Roy. Soc. London, B* 222: 29–45.
- Scott, D. H. (1912). On *Botrychioxylon paradoxum*, sp. nov., a Palaeozoic fern with secondary wood. *Trans. Linn. Soc. London (Bot.)* II, 7: 373–389.
- , (1923). *Studies in Fossil Botany*. II.
- Wilson, L. R., and A. W. Johnston. (1940). A new species of *Cordaites* from the Pennsylvanian strata of Iowa. *Bull. Torr. Bot. Club* 67: 117–120.

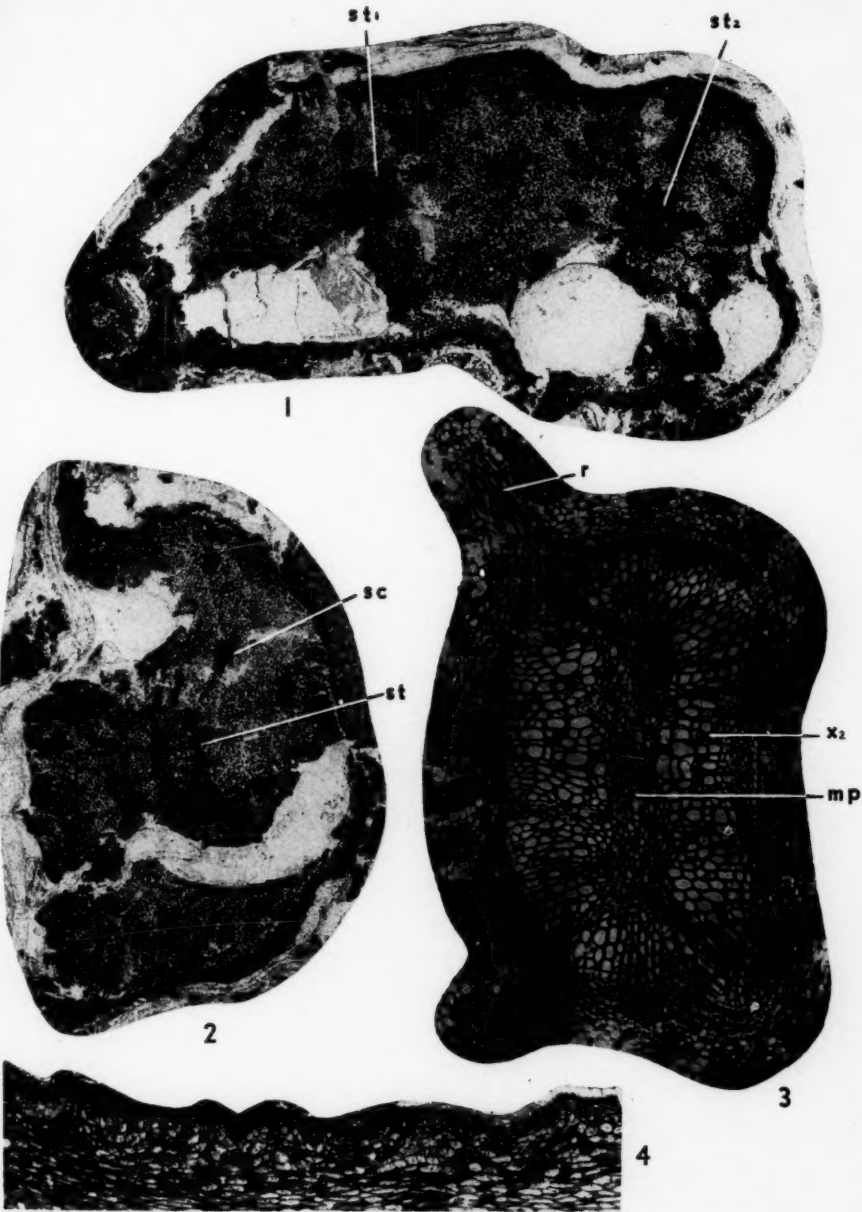
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EXPLANATION OF PLATE

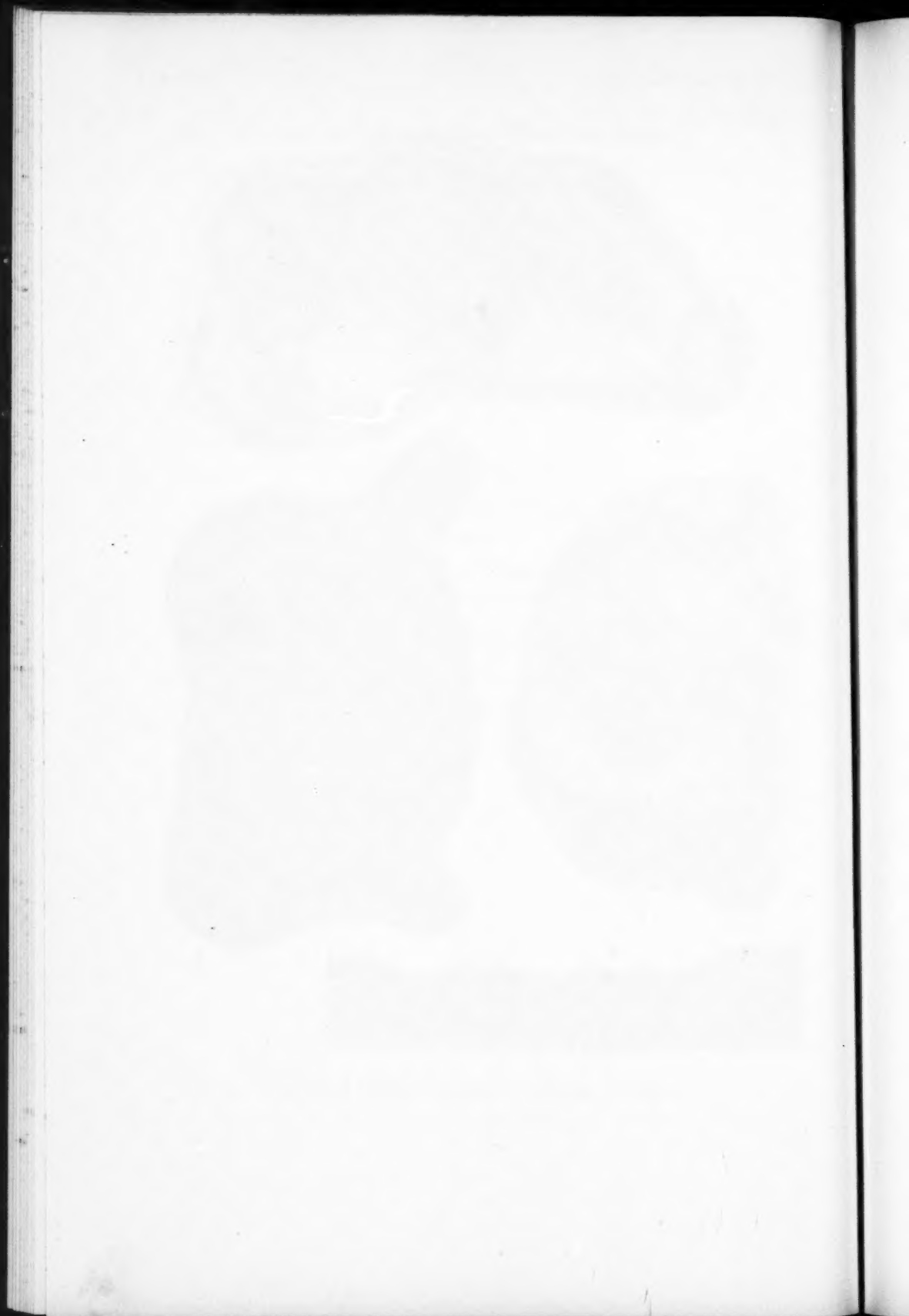
PLATE 1

Scleropteris illinoensis

- Fig. 1. Transverse section through the stem showing dichotomy of the stele, *st*. WCB90B.B11, $\times 4.5$.
- Fig. 2. Transverse section through the stem; *sc*, sclerotic nests; *st*, stele. WCB90C.T15, $\times 5.5$.
- Fig. 3. Transverse section through the stele; *mp*, mixed pith; *x_s*, secondary xylem; *r*, departing root. WCB90C.T2, $\times 20$.
- Fig. 4. Longitudinal section through the outer cortex showing bases of emergences. WCB90B.S22, $\times 17$.



ANDREWS—AMERICAN CARBONIFEROUS FLORAS. I

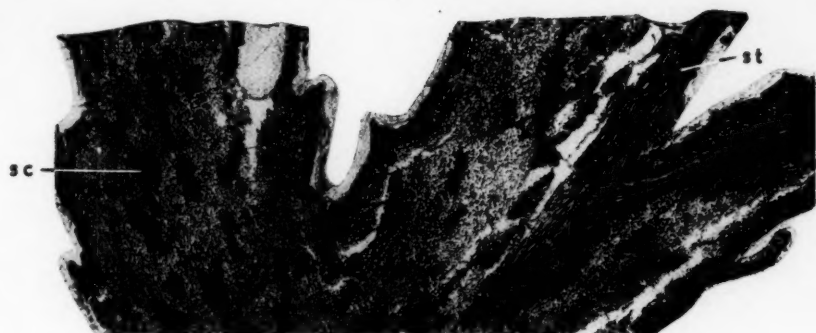


EXPLANATION OF PLATE

PLATE 2

Scleropteris illinoensis

- Fig. 5. Longitudinal section showing branching of stem: *st*, stele; *sc*, sclerotic nests. WCB90B.S35, $\times 4$.
- Fig. 6. Longitudinal section through cortex showing an emergence and sclerotic nests. WCB90B.S27, $\times 8$.
- Fig. 7. Radial longitudinal section through stele: *px*, protoxylem (!). WCB90B.S22, $\times 150$.



5



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px

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ANDREWS—AMERICAN CARBONIFEROUS FLORAS. I

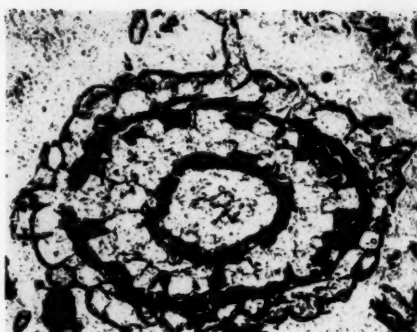
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PLATE 3

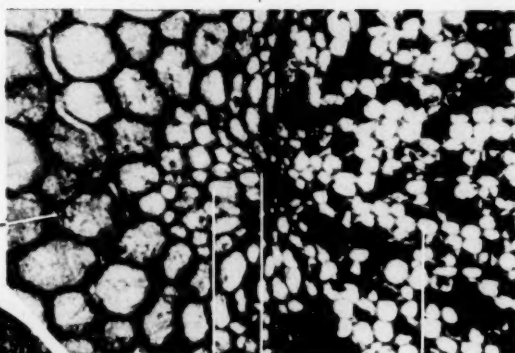
- Fig. 8. Rootlet, probably belonging to *Mesoxylon*, bearing root hairs. WCB31F.T4, $\times 93$.
Fig. 9. Portion of another rootlet shown at a higher magnification. WCB31F.T4, $\times 260$.
Fig. 10. *Mesoxylon Nauertianum*. Portion of the stem showing centripetal development of the primary xylem: *p*, pith, *pr*, protoxylem, *m*, centripetal metaxylem, *x*, secondary xylem. WCB53B-B.S8, $\times 80$.
Fig. 11. *Scleropteris illinoensis*. Tangential section through the central portion of the stem; *r*, roots. WCB90C.T9, $\times 20$.
Fig. 12. *Scleropteris illinoensis*. Tangential section through the secondary xylem showing tracheids and rays. WCB90B.S32, $\times 70$.



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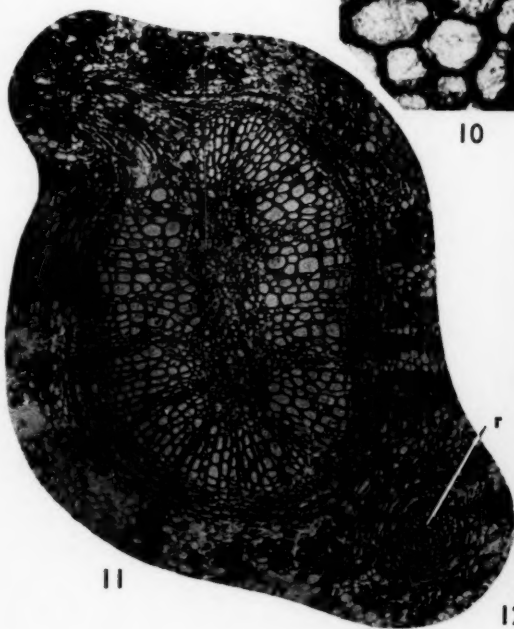
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ANDREWS—AMERICAN CARBONIFEROUS FLORAS. I



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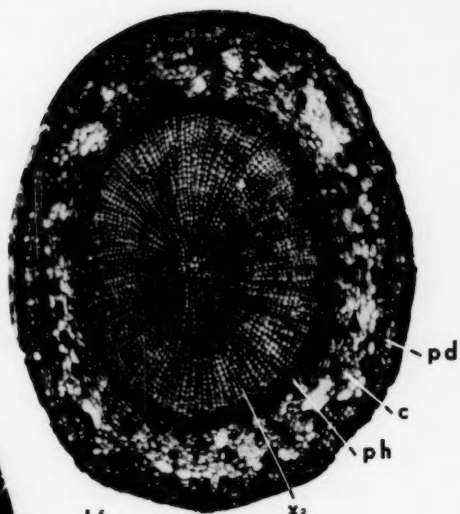
PLATE 4

Mesozylon Nauertianum

- Figs. 13-15. Stages in the departure of a root from the stem: fig. 13, WCB92A.1; fig. 14, WCB92A.2; fig. 15, WCB92A.3. All figures $\times 5$.
- Fig. 16. Same root as shown in preceding figures after departure from the stem; x_2 , secondary xylem; ph , phloem; c , cortex; pd , periderm. WCB92A.4, $\times 20$.
- Fig. 17. Tangential section through the secondary wood of the stem. $\times 110$.



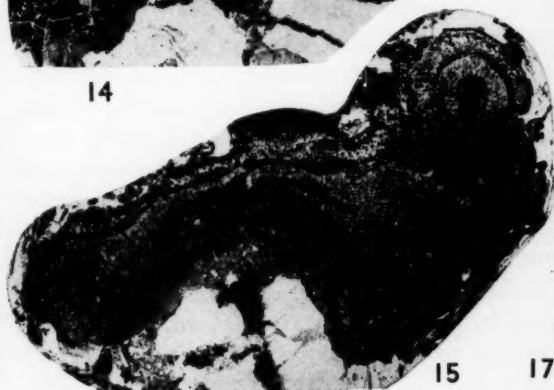
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17



CONTRIBUTIONS TO OUR KNOWLEDGE OF AMERICAN CARBONIFEROUS FLORAS¹

II. LEPIDOCARPON

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In recent investigations of the American Pennsylvanian coal-balls, no less than three new species of *Lepidocarpon* have been described in as many years (Darrah, '41; Hoskins and Cross, '41; Schopf, '38). However, much still remains to be known about this interesting and important fossil, particularly its relationships to the various other Lycopod organs that are frequently found associated with it. It is perhaps especially significant that we are able to present at this time descriptions of both a well-preserved gametophyte bearing archegonia and the microsporangiate strobilus of a *Lepidocarpon* from southern Illinois. Gametophytes have been reported for the genus but never undoubted archegonia, so far as we are aware, nor microspore-bearing organs.

Materials and Procedure.—

All of the material described below was obtained from the Pyramid Mine of the Binkley Coal Company, Perry County, Illinois. Our collections contain two species of Lycopod seeds, an *Illinio-carpon*, probably *I. Cadyi* Schopf, and the *Lepidocarpon* described here. Numerous specimens of the latter have been found but thus far we have but one in which the gametophyte is preserved. It was found in a coal-ball numbered WCB56 in our collections, and all references in this paper pertain to that specimen. Other parts of this particular seed are not as well preserved as certain of the specimens lacking a gametophyte, particularly WCB55. These two serve as the basis of the following description, although our knowledge of the species has been supplemented by numerous other specimens.

The original saw cut through WCB56 was apparently near one

¹ A study financed in part by a grant from the Penrose Fund of the American Philosophical Society.

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end of the gametophyte. A ground section was prepared from one half and a series of nearly 200 peels, extending through a radial distance of about one cm., from the other half. In WCB55 a series of 170 peels, as well as some ground sections, was made in order to follow the structural changes that take place between the proximal and distal ends.

Our knowledge of the "male" strobili is based on abundant microspores which occur within the seeds and two partially complete cones bearing mature microspores *in situ*. Series of transverse and longitudinal sections were prepared through these strobili.

Inasmuch as the seeds that we refer herewith to *Lepidocarpon* are typical for the genus, it does not seem necessary to describe in detail all of the better-known features. Inclusive generic descriptions may be found in Scott's ('01) monumental treatise as well as the more recent work of Hoskins and Cross ('41) and Schopf ('41). Our descriptions will stress, rather, those points that are previously unreported or poorly understood.

The Seed.—

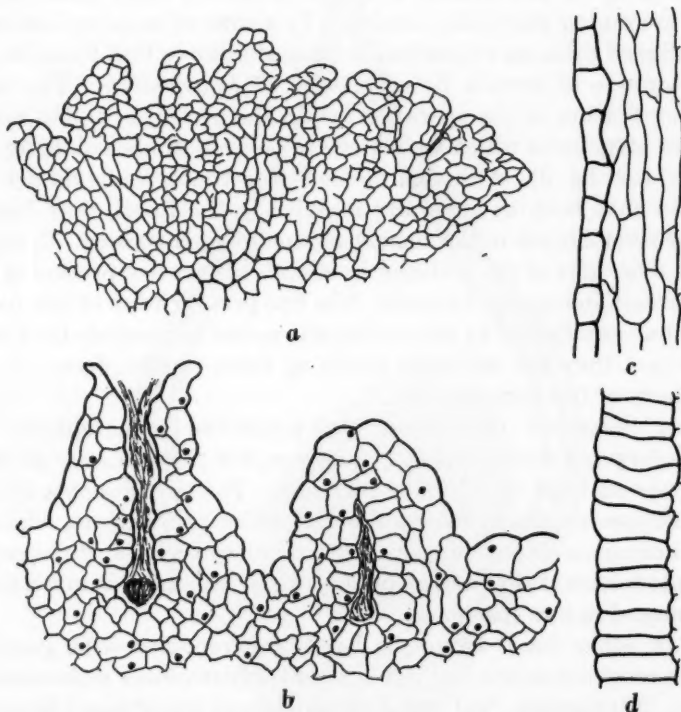
Seven preparations have been selected from the series made from specimen WCB55 to illustrate in tangential section the structure of a typical seed. These are shown in figs. 1-4, 7, 8 and 13 of pls. 5-7. Figure 1 shows the proximal end of the seed near its attachment to the axis; figs. 2 and 3 are from points approximately $\frac{1}{4}$ and 1 mm. farther out, the sporangium appearing in the former; fig. 7 is from the central region; fig. 4 is from a point midway between fig. 7 and the distal end, while figs. 8 and 13 are close to the outside.

It may be noted that the seed as a whole is comparatively narrow close to the cone axis and gradually broadens, the base becoming extremely massive toward the distal end. An interesting feature appears in fig. 8 where two loops appear on either side and immediately below the vascular bundle; in fig. 13 these have united, cutting off what is, in fact, the lower (dorsal) lobe or "heel" of the sporophyll.

The cellular structure of the sporangium wall is well preserved and consists of an outer layer of comparatively thick-walled, brick-shaped cells enclosing a zone of more delicate elongate ones (text-fig. 1c). As will be noted on a later page, the outer mechanical cells are quite different from the corresponding tissue found in the microsporangium (text-fig. 1d). At either side of the base of the sporangium there is a supporting tissue of thick-walled cells following up

the sporangial wall and adjoining portion of the sporophyll for a short distance (text-fig. 2).

Although the vascular bundle is well preserved, no part of it can unhesitatingly be called protoxylem. As in *L. Lomaxi*, transfusion tissue is present at least toward the distal end (pl. 7, fig. 14). Parichnos strands, or the cavities left after the decay of the delicate



Text-fig. 1. *a*, *Lepidocarpon magnificum*, part of the gametophyte bearing archegonia, from slide WCB56B.12, $\times 65$; *b*, part of the gametophyte of *Lycopodium obscurum*, from a slide in the Eames Collection, Cornell University, $\times 185$; *c*, a portion of the megasporangium wall of *L. magnificum*, $\times 250$; *d*, a portion of the microsporangium wall of *L. magnificum*, $\times 250$.

tissue composing them, are present throughout the length of the sporangial region although they are much more strongly developed in the distal end (figs. 4, 8, 13, of pls. 5-7).

The Gametophyte.—

A distinctive and rather surprising feature of the gametophyte described here is its small size compared with the seed as a whole

(pl. 6, fig. 11). Although both its distal and proximal ends are poorly preserved, the more or less cylindrical form and orientation in life, as shown in fig. 12, remain constant through the series of 200 peels. Its diminutive size, which presents a contrast to other described Lycopod gametophytes, will be discussed in a later paragraph.

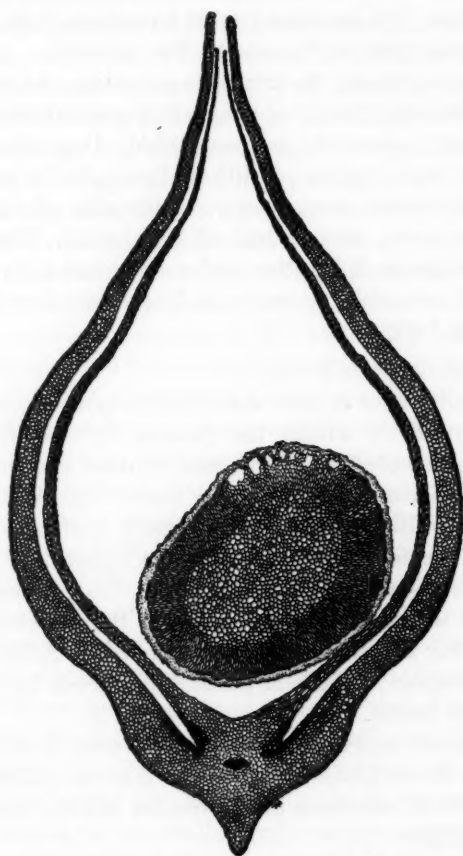
The gametophyte is composed of two distinct cellular regions as shown in fig. 12 and text-fig. 2: a central core of large isodiametric cells, averaging about $66\ \mu$, enclosed by a zone of more or less radially aligned cells, an organization quite similar to that found in the gametophyte of certain living species of *Lycopodium*. The most striking feature of the specimen lies in the presence, on the upper side, of structures which we believe to be archegonia (pl. 6, fig. 12, *ar*, and text-fig. 2). Although the neck and venter walls do not appear to have been as generally massive in the fossil, they bear a strong resemblance to the female organs of *Lycopodium*. Camera-lucida drawings of the archegonia of both genera are presented for comparison in text-fig. 1*a* and *b*. The fine preservation of the tissue immediately adjacent to the archegonia seems to preclude the possibility that they are artifacts resulting from partial decay of the periphery of the gametophyte.

Scott described the rather well-preserved gametophytes of *Lepidocarpon Lomaxi* and *L. Wildianum*, but they differ in at least two respects from our Illinois specimen. The gametophyte of the English species fills or nearly fills the entire sporangium, while in ours it occupies a much smaller portion and the cellular differentiation into a central core and an outer peripheral region is much more pronounced in our specimens.

A few other fossil Lycopods have been reported with gametophytes, most noteworthy of which are *Lepidostrobis Veltheimianus* (Scott, '20; Gordon, '10) and *Lepidodendron esnostense* (Renault, 1896). These species are not as well preserved nor do they present points of close similarity with the one described here. Of the American Lycopod seeds described in recent years (Krick, '32; Reed, '36, '41; Schopf, '38; Darrah, '41; Hoskins and Cross, '41) in only one is the gametophytic tissue preserved. With reference to his *Lepidocarpon glabrum*, Darrah notes that "The gametophyte is extensive, nearly filling the whole cavity" (p. 99), but his description and illustrations are not sufficiently detailed to allow comparison.

The small size of our gametophyte is a feature deserving further comment. Since it is the only one that we have found, it is impossible

to state for certain whether or not it is typical. If so, then it would seem that we are dealing with a more primitive seed than previously described species, such as *L. Lomaxi*, and one in which possibly more than one megaspore was functional.



Text-fig. 2. Restoration of a seed of *Lepidocarpon magnificum*, taken approximately midway between the proximal and distal ends; from slides WCB55L.14, WCB55L.o3, WCB56B.12, WCB56B.39.

It is not entirely improbable that certain of those fossil Lycopods which attained the seed level produced more than one embryo in each seed. Professor A. J. Eames has kindly shown the senior author single gametophytes of living species of *Lycopodium* col-

lected near Ithaca, N. Y., bearing as many as seven sporelings in an advanced stage of development.

Judging from what we know of the structure of mature specimens of *Lepidocarpon* in general, and that is now quite extensive, they were not seeds constructed to withstand long periods of adverse conditions. The survivors must have been those that were deposited in moist places favorable for growth. A hypothetical *Lepidocarpon* combining the multiple sporeling character of *Lyco-podium* with the potentiality of possessing more than one functional megaspore may reasonably be postulated. Deposited, as most of them probably were, under conditions favorable to quick germination such seeds would have been exceptionally efficient, no matter how primitive from a morphological standpoint. That such an organ would encounter difficulties under more xerophytic conditions is obvious and probably accounts in large part for the decline of the arborescent forms.

The Microsporangiate Cones.—

In the earlier phases of this study microspores were observed in considerable numbers within the gametophyte-bearing seed, and further search revealed their presence in other specimens. At least four different species of spores have been found in the seeds, two of which are most likely fern spores (figs. 5, 6, of pl. 5), while other larger ones characterized by a prominent equatorial wing are referable to *Endosporites* (Wilson and Coe, '40). These are briefly mentioned for whatever ecological value they may present. The fourth and by far the most abundant (pl. 6, figs. 9, 10) are believed to be the microspores of the *Lepidocarpon* seeds for reasons that will be set forth below.

The presence of microspores within the seed is of considerable significance in the establishment of the true morphological status of the genus. With reference to the species that he described, Scott wrote ('01, p. 322):

"Unfortunately we are at present unable to decide whether pollination, in *Lepidocarpon*, took place on the parent plant or not. Microspores have not been observed within the integument of the megasporangium, nor is there anything of the nature of a pollen-chamber to receive them. We must therefore take into account the possibility that the seed-like organs of *Lepidocarpon* may have served merely for the protection of the megaspores and prothallus; that they were shed first and received the microspores afterwards. On this supposition, it is possible that all the specimens observed, including those with prothalli, were still unfertilized or even unpollinated. If this were so, the organs in question were certainly not true seeds, though it is possible that the evolution of true seeds may have started in the same way."

The abundance of microspores in our seeds renders highly improbable their presence as the result of chance entry after shedding. It seems certain that they have been deposited through a normal pollination process. We may pass now to a consideration of the microsporangiate cones themselves.

Two partially complete strobili have been obtained from the Pyramid Mine, numbered WCB166 and WCB172 in our collections. The former measures approximately 16 cm. long and in life was about 5 cm. in diameter, although only one longitudinal half is preserved. Toward one end the woody axis is complete and quite well preserved, and although most of the sporangia have dehisced a few still retain their spores. In the other specimen (WCB172) the cone is 15 cm. long by 5 cm. in diameter and runs through the entire length of the coal-ball. It was apparently somewhat longer in life.

The xylem of the cone axis measures 1.4 mm. in diameter and is siphonostelic, enclosing a central pith cavity 0.6 mm. in diameter. The pith, as well as the tissue immediately outside the xylem, is not preserved. About 34 protoxylem points are distributed about the periphery of the woody axis in an exarch position.

The structure and arrangement of the sporophylls midway between their proximal and distal ends are shown in fig. 20 of pl. 8. Like the seeds, they become massive toward the outside where parichnos strands are well developed and a ligule is present (pl. 7, fig. 16, pl. 8, fig. 18). The organization of the sporophylls is uniform throughout the length of the cone and likewise the size and form of the contained spores. In fig. 15 a part of one of the cones is illustrated in which certain sporangia have retained their spores. A portion of one of these sporangia is shown at a higher magnification in fig. 19. Two particularly significant features may be noted here: first, the columnar outer cells which are elongated at right angles to the surface (averaging $15 \times 45 \mu$) are quite in contrast to the horizontally elongated corresponding cells in the megasporophylls (cf. text-fig. 1c and d); second, the persistence of the mature spores in tetrads. A few of the latter are shown at a higher magnification in pl. 7, fig. 17. They are uniform in size and shape and average 26μ . If, now, these spores and those present in the seeds (figs. 9, 10) be compared (the two are illustrated at the same magnification), the very close similarity is apparent. *However, not only are they strictly comparable in size and form but, as noted above, they frequently occur in tetrads in the seeds as well as in the microspor-*

angia. The abundance of these microspores in the seeds, combined with the fact that individually they are indistinguishable from those borne in the microsporangiate cones, leaves no doubt that the latter and the *Lepidocarpon* seeds belong to the same species.

In view of the numerous previously unrecorded features characterizing our specimens it seems advisable to introduce a new specific name.

***Lepidocarpon magnificum* Andrews and Pannell, sp. nov.**

Diagnosis.—

Seeds detached, 19–20 mm. long (parallel to sporophyll pedicel and not including free portion of lamina), approximately 6 mm. broad by 11 mm. high in the central portion; one functional megaspore occupying about one quarter of the sporangial cavity, columnar cells of sporangium wall horizontally elongated, gametophyte well developed and composed of a central mass of isodiametric cells surrounded by a broad zone of smaller, more or less radially arranged cells; apparent archegonia borne in the upper portion; microspores abundant within the sporangium; microsporangiate cones at least 16 cm. long by 5 cm. in diameter, columnar cells of sporangial wall vertically elongated, microspores $26\ \mu$ in diameter, tending to remain in tetrads when mature. Locality and horizon: Pyramid Mine of the Binkley Coal Company, 3 miles south of Pinckneyville, Illinois; coal #6, Upper Carboniferous.

Discussion.—

The microsporangiate cones that we have assigned to *Lepidocarpon magnificum* agree closely with *Lepidostrobus Coulteri* Jongmans as described by Coulter and Land ('11, '21) and Mathews ('40). It is highly probable that the latter are specifically comparable with those described here, but although we have no hesitancy in referring our own specimens to *L. magnificum* it is perhaps best to retain *Lepidostrobus Coulteri* (for Coulter and Land's specimens) until a monographic work of the group is prepared.

In his account of the English species, Scott ('01) mentions a microsporangiate cone as questionably referable to *L. Lomaxi* but due to the uncertainty involved he did not include a description of it. The supposed relationship of this cone to *Lepidocarpon* was based on "The presence of rudimentary integuments, together with agreement in details of structure and the evidence of association. . . ." [p. 314]. Further discussion of that species can be of little avail until additional collections of it are at hand.

It is clear that in the two microsporangiate cones described there is no indication of an integument enclosing the sporangia. They are mature and strictly microsporous and, in themselves, typical *Lepidostrobus* cones. However, the occurrence of the microspores in the seeds, as noted in detail above, affords sufficient evidence in our opinion for their reference to *L. magnificum*.

The only possible doubtful feature of our taxonomic treatment of the microsporangiate cones and seeds is the contrasting structure of the outer mechanical cells of their respective sporangia. It must be remembered, however, that this tissue is a highly specialized dehiscence mechanism allowing dissemination of the microspores, and likewise megaspores in forms such as *Selaginella* and *Lepidostrobus* where a true seed habit has not been reached. With the evolution of the permanent retention of a single functional megaspore the need for such a tissue diminishes, although the sporangium must of course be opened sufficiently to admit the microspores. Inasmuch as the function of the microsporangium apparently remained more nearly static during this seed development, it is logical that its structure should remain the same. For the same reason the absence of an "integument" from the microsporangium in no way invalidates the apparent relationship to the seed.

It becomes increasingly clear that the Lepidocarpaceae is a diverse group and one whose taxonomy will undergo frequent revisions in the future.

Acknowledgment.—

We are indebted to Professor A. J. Eames for his helpful criticism and for the opportunity to study his fine collection of *Lycopodium* gametophytes.

Literature cited.—

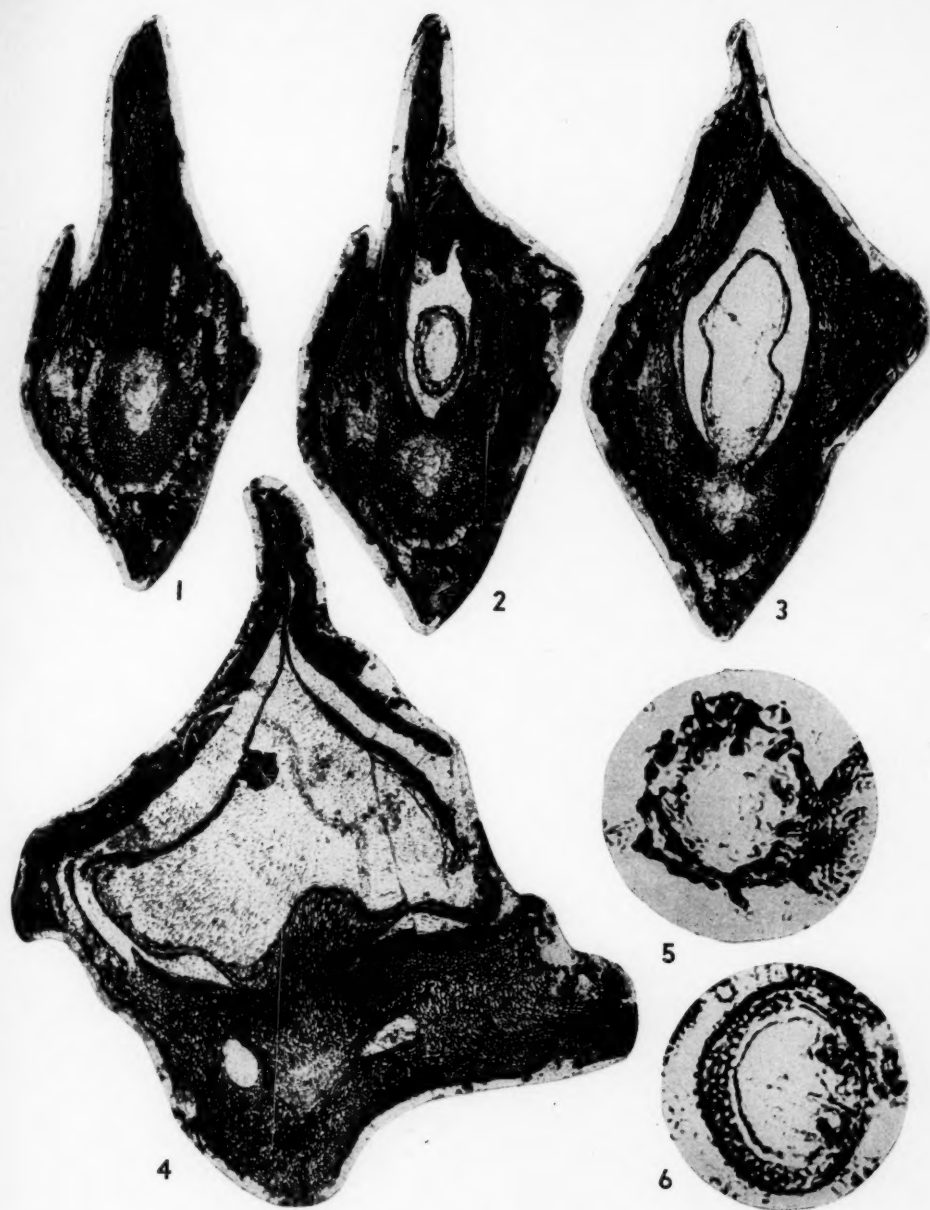
- Coulter, J. M., and W. J. G. Land. (1911). An American *Lepidostrobus*. *Bot. Gaz.* 51: 449-453.
- , (1921). A homosporous American *Lepidostrobus*. *Ibid.* 72: 106-108.
- Darrah, W. C. (1941). The fossil flora of Iowa coal-balls. IV. *Lepidocarpon*. *Bot. Mus. Leaf. Harv. Univ.* 9: 85-100.
- Gordon, W. T. (1910). Notes on the prothallus of *Lepidodendron Veltheimianum*. *Ann. Bot.* 24: 821-822.
- Hoskins, J. H., and A. T. Cross. (1941). A consideration of the structure of *Lepidocarpon* Scott based on a new strobilus from Iowa. *Am. Midl. Nat.* 25: 523-547.
- Krick, H. V. (1932). Structure of seedlike fructifications found in coal balls from Harrisburg, Illinois. *Bot. Gaz.* 93: 151-172.
- Mathews, G. B. (1940). New *Lepidostrobi* from Central United States. *Ibid.* 102: 26-49.
- Reed, F. D. (1936). *Lepidocarpon* sporangia from the Upper Carboniferous of Illinois. *Ibid.* 98: 307-316.

- , (1941). Coal flora studies: *Lepidodendrales*. *Ibid.* 102: 663-683.
- Renault, B. (1896). *Étude des gîtes minéraux de la France. Bassin Houiller et Permien d'Autun et d'Épinac. Flore Fossile.* Paris.
- Schopf, J. M. (1938). Two new Lycopod seeds from the Illinois Pennsylvanian. *Ill. State Geol. Surv. Cir.* 28: 139-146.
- , (1941). Notes on the *Lepidocarpaceae*. *Am. Midl. Nat.* 25: 548-563.
- Scott, D. H. (1901). On the structure and affinities of fossil plants from the Paleozoic rocks. IV. The seed-like fructifications of *Lepidocarpon*, a genus of Lycopodiaceous cones from the Carboniferous formation. *Phil. Trans. Roy. Soc. Lond.* B194: 291-333.
- , (1920). *Studies in Fossil Botany.* I.
- Wilson, L. R., and E. A. Coe. (1940). Descriptions of some unassigned plant microfossils from the Des Moines Series of Iowa. *Am. Midl. Nat.* 23: 182-186.

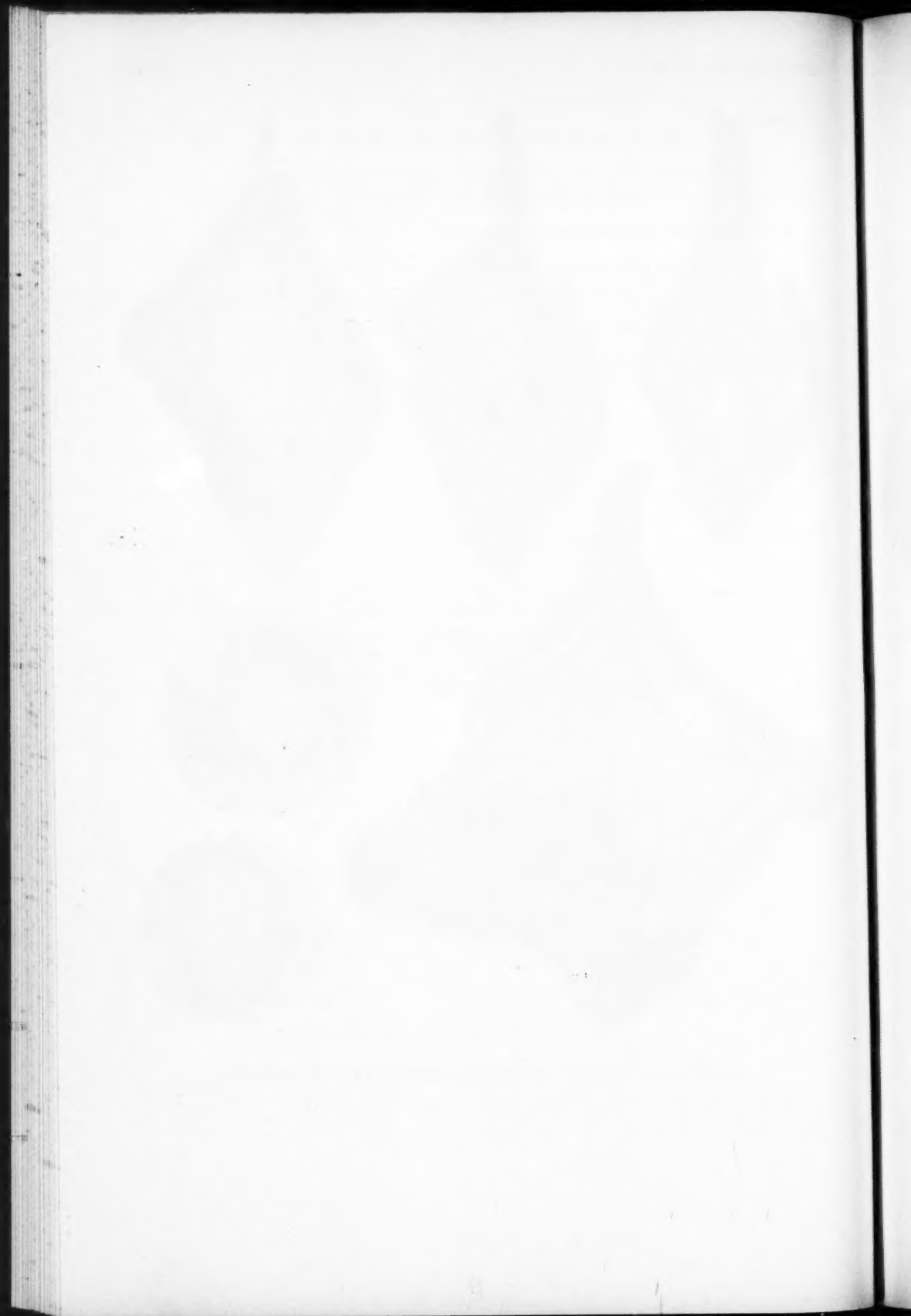
EXPLANATION OF PLATE

PLATE 5

- Figs. 1-4. *Lepidocarpon magnificum*. Part of a series of peel preparations starting near the point of attachment to the cone axis and progressing toward the distal end: fig. 1, WCB55I.02; fig. 2, WCB55I.04; fig. 3, WCB55I.013; fig. 4, WCB55II.12. All figures $\times 11$ except fig. 4, which is $\times 10$.
- Figs. 5, 6. Foreign spores, probably of ferns, found within the seed of *Lepidocarpon*: fig. 5, WCB56B.12; fig. 6, WCB56B.41. Both figures $\times 700$.



ANDREWS & PANNELL—AMERICAN CARBONIFEROUS FLORAS. II

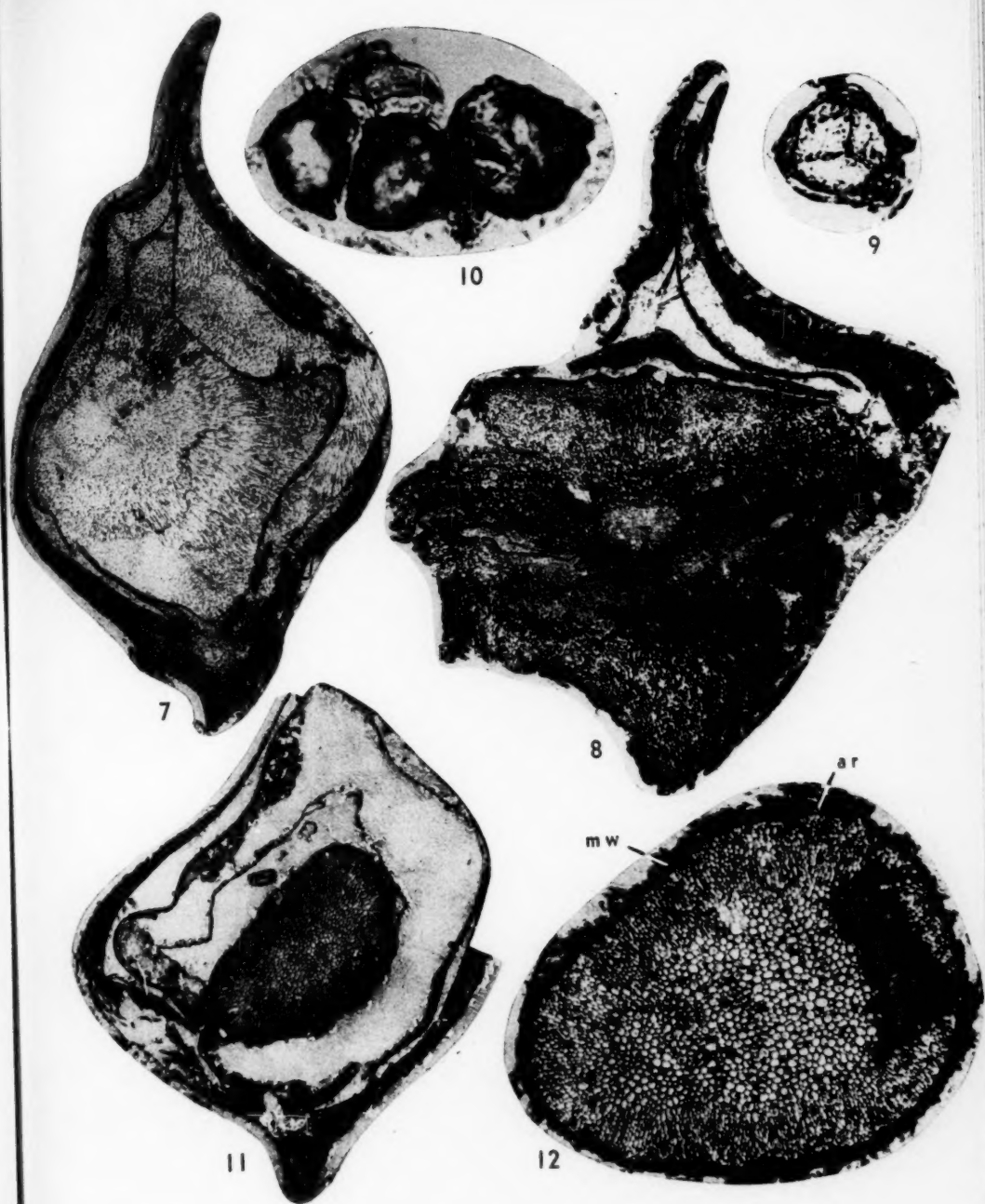


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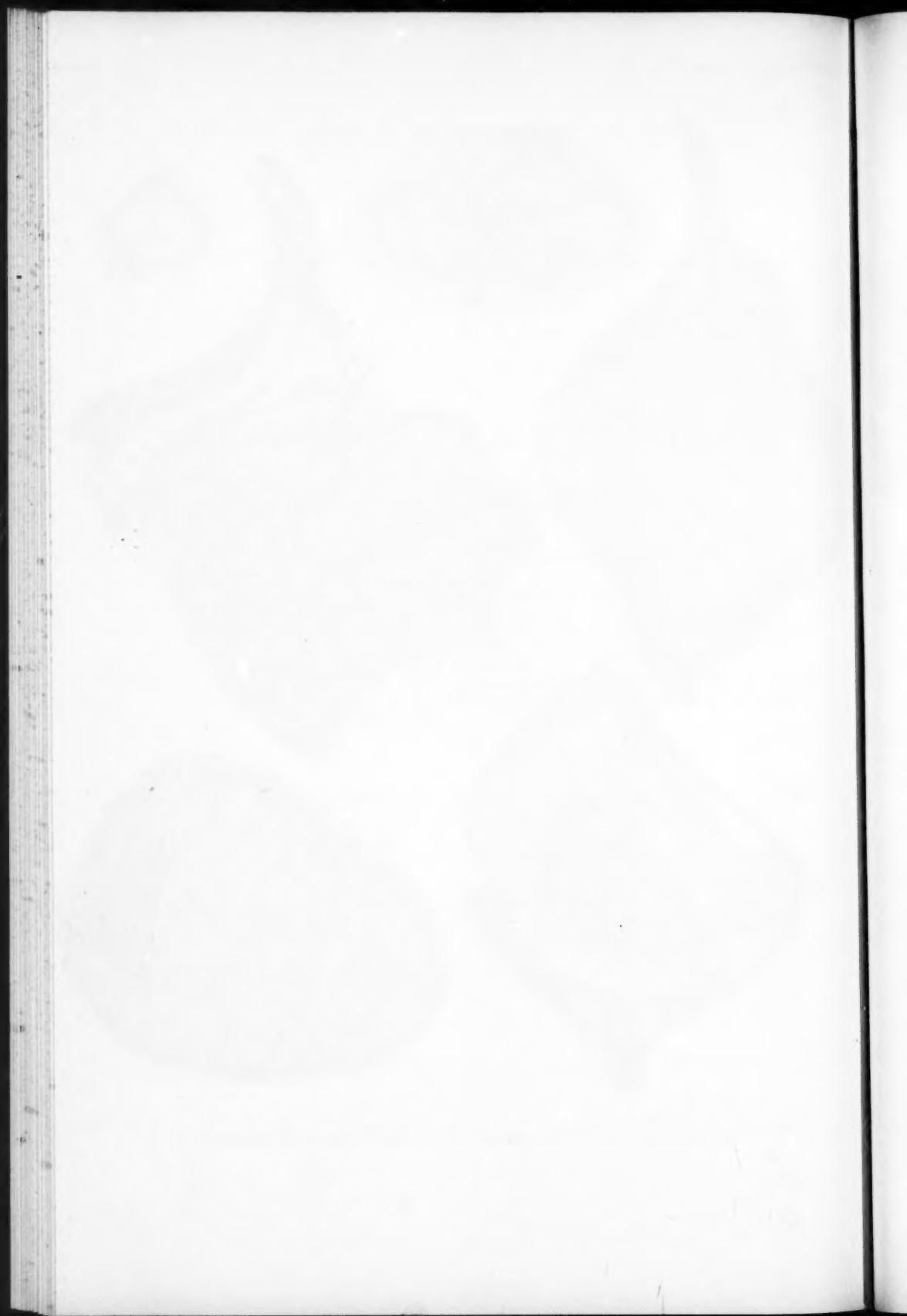
PLATE 6

Lepidocarpon magnificum

- Figs. 7, 8. Part of the series shown in figs. 1-4, explanation in text: fig. 7, WCB55I.016; fig. 8, WCB55IIL.01. Both figures $\times 10$.
- Figs. 9, 10. Microspores found within the seed: fig. 9 shows characteristic retention of the tetrad after dispersal, WCB56B.9; fig. 10, a single spore showing triradiate commissure, WCB56B.23. Both figures $\times 700$.
- Figs. 11, 12. Photographs of the specimen bearing a gametophyte: fig. 11, from WCB56B.1, $\times 12$; fig. 12, the gametophyte enlarged; *ar*, archegonia; *mw*, megaspore wall; from WCB56B.12, $\times 20$.



ANDREWS & PANNELL—AMERICAN CARBONIFEROUS FLORAS. II

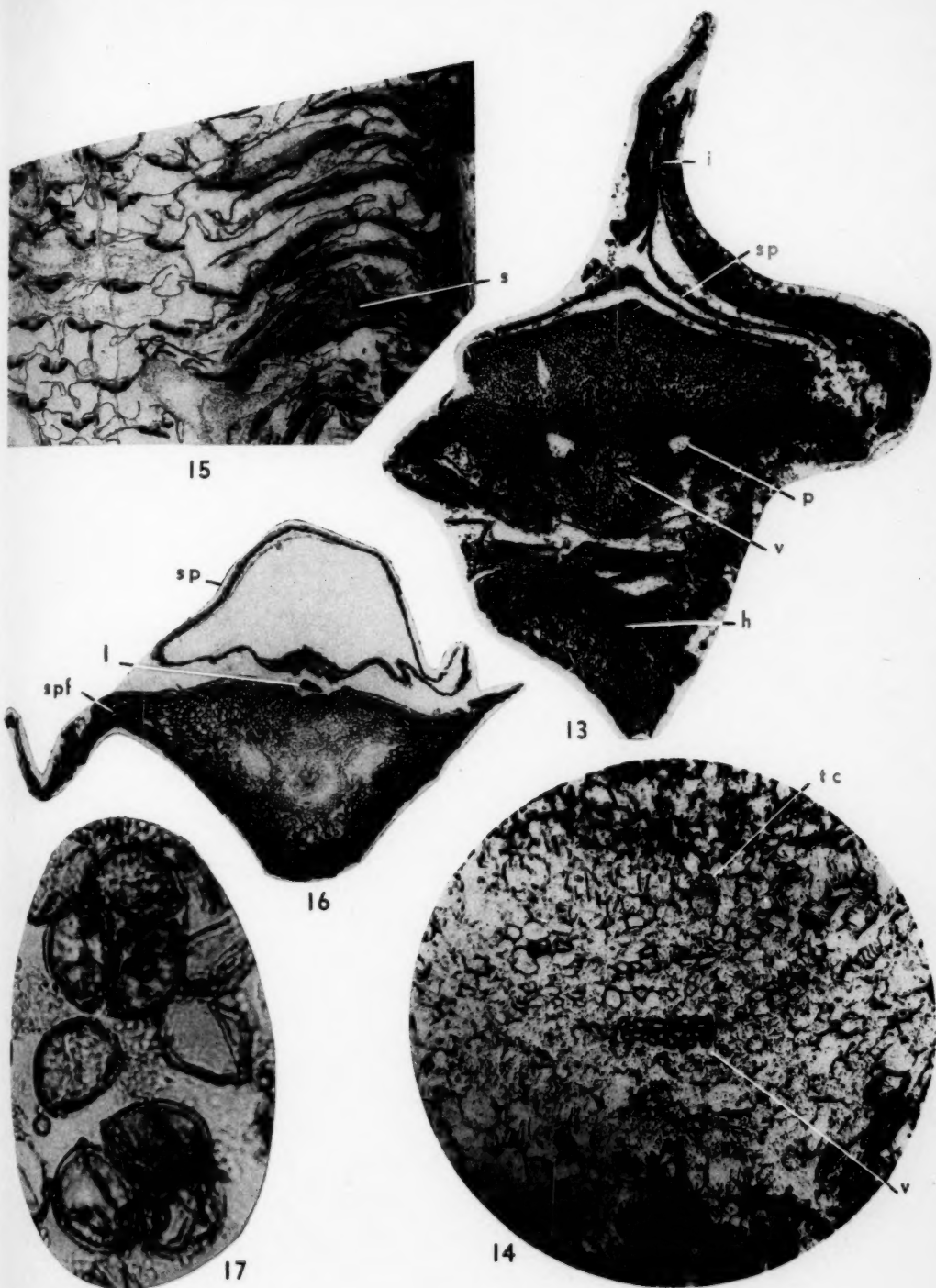


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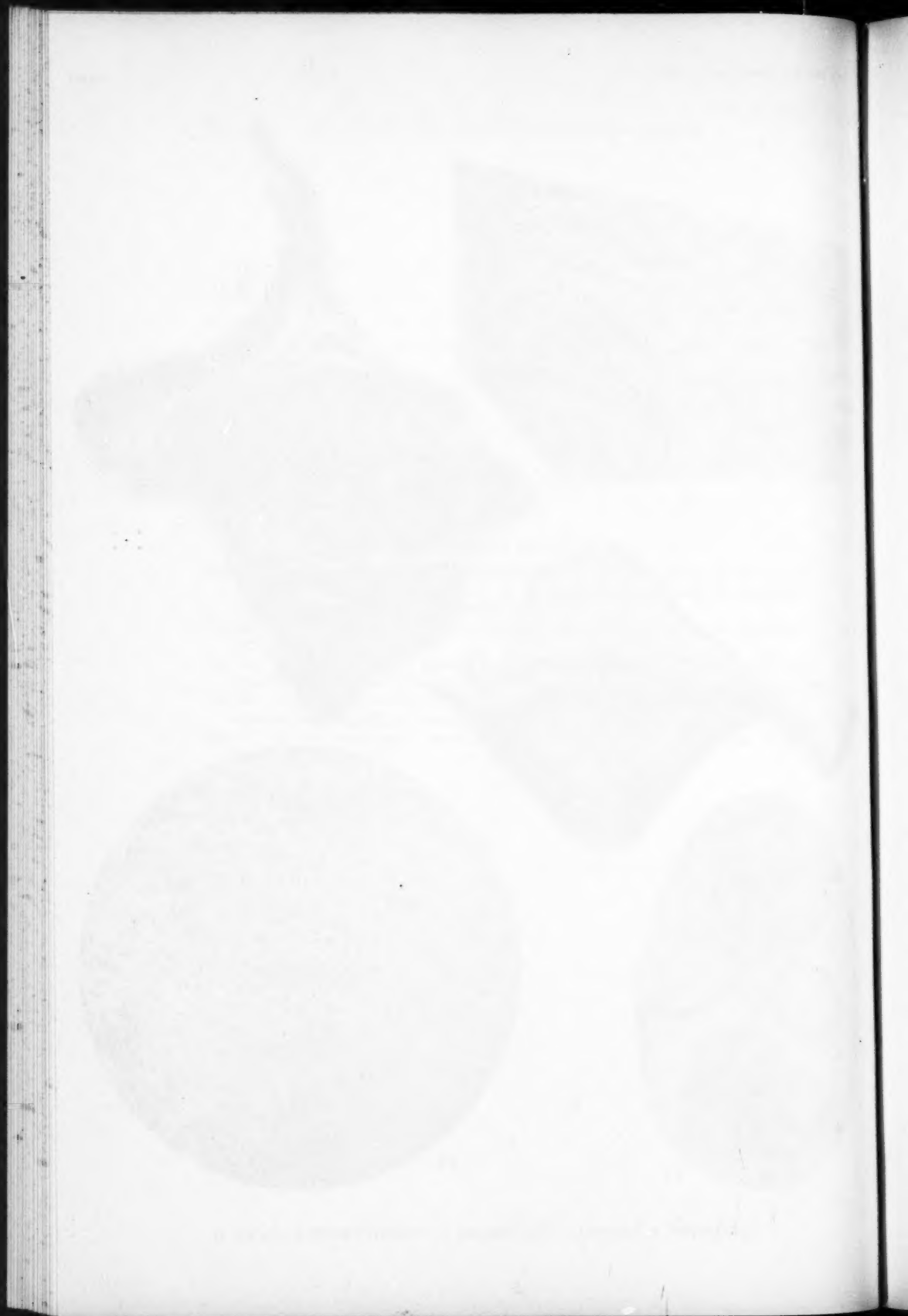
PLATE 7

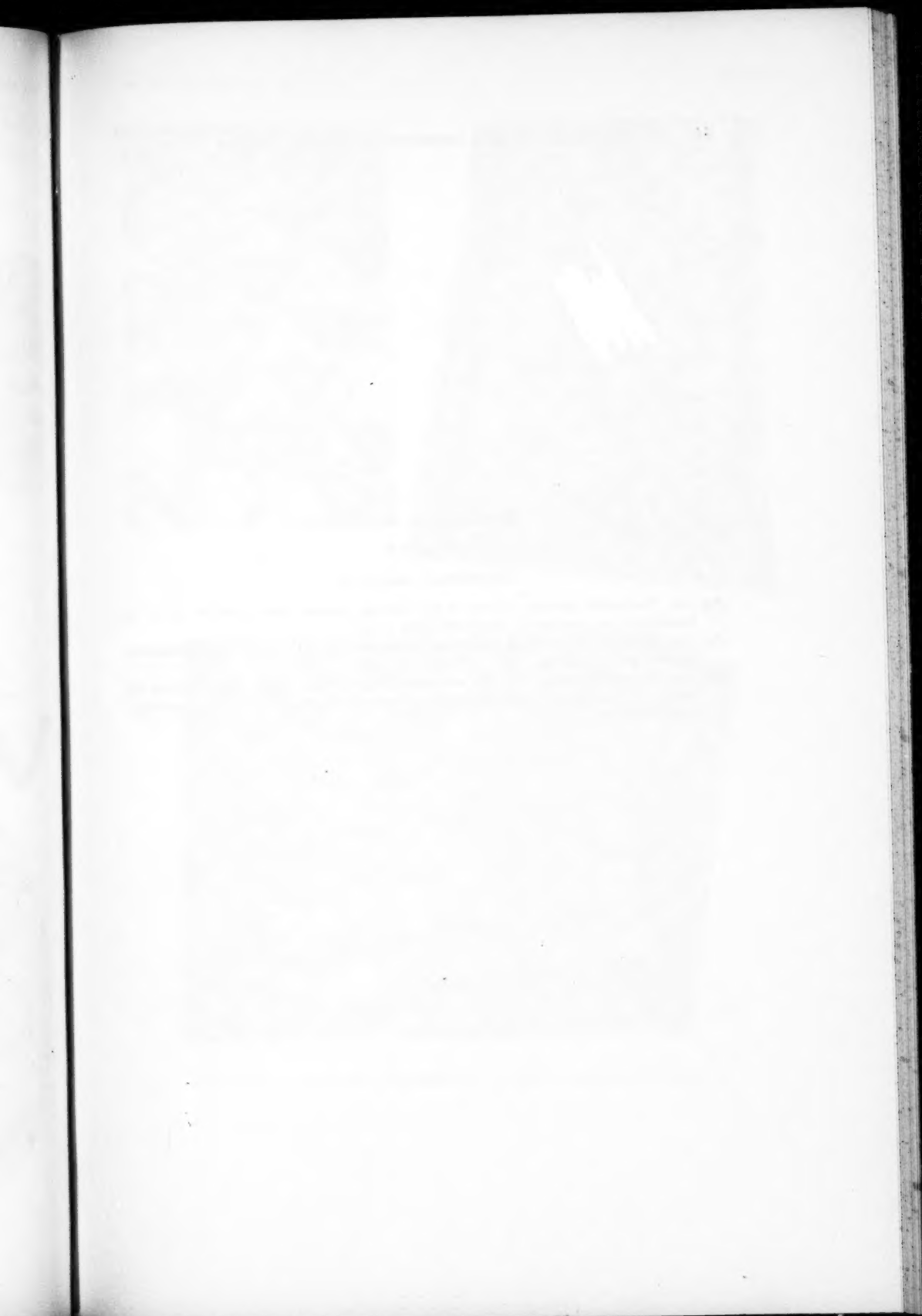
Lepidocarpon magnificum

- Fig. 13. Tangential section near the distal end of the sporophyll shown in figs. 1-4, 7 and 8; *p*, parichnos; *i*, integument; *sp*, sporangium wall; *h*, heel of sporophyll; *v*, vascular bundle. From WCB55III.09, $\times 10$.
- Fig. 14. Enlarged bundle region of the seed, showing *v*, vascular bundle, *tc*, transfusion cells. From WCB55III.i4, $\times 80$.
- Fig. 15. Longitudinal section through part of a microsporangiate cone. Most of the sporangia have dehisced although a few retain their spores, *s*. WCB166B2.S3, $\times 3.1$.
- Fig. 16. Longitudinal section of a microsporophyll from near the distal end; *sp*, sporangium; *l*, ligule; *spf*, sporophyll. WCB172C.S16, $\times 12.5$.
- Fig. 17. A few microspores showing the characteristic retention of the tetrad. WCB166B1.S2, $\times 700$.



ANDREWS & PANNELL—AMERICAN CARBONIFEROUS FLORAS. II





EXPLANATION OF PLATE

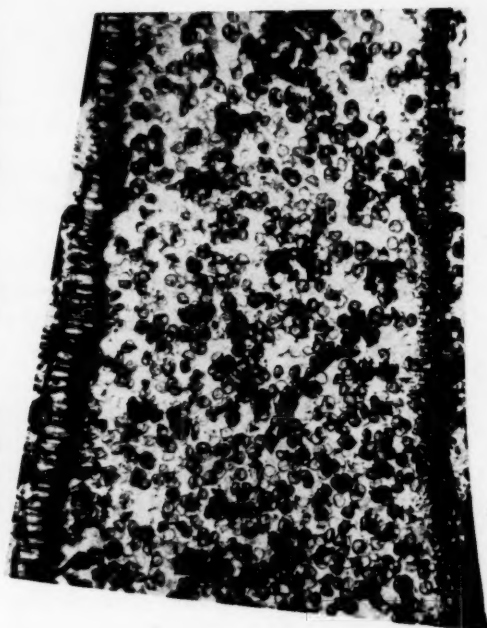
PLATE 8

Lepidocarpon magnificum

- Fig. 18. Tangential section of part of the microsporangiate cone near the distal extremity of the sporophylls. WCB172C.S16, $\times 3.5$.
- Fig. 19. Part of a sporangium containing microspores from the specimen illustrated in fig. 15. WCB166B1.S2, $\times 80$.
- Fig. 20. Tangential section through a microsporangiate cone, taken about midway between the cone axis and distal end of the sporophylls, showing the dehiscent sporangia. WCB172C2.S2, $\times 3.5$.



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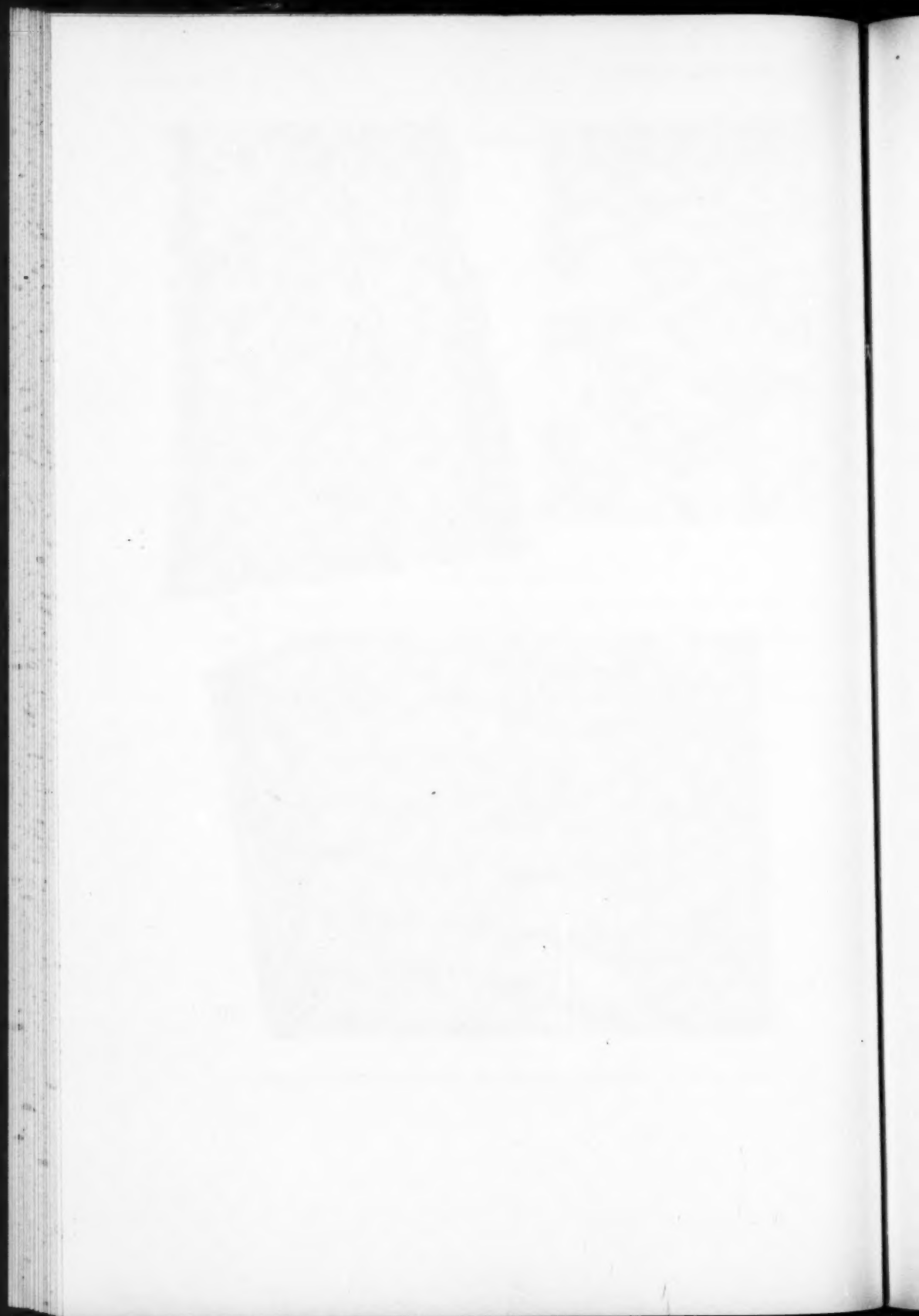


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ANDREWS & PANNELL—AMERICAN CARBONIFEROUS FLORAS. II



NEW GESNERIACEAE FROM PANAMA¹

C. V. MORTON

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The many botanical collections that have been made recently in Panama, chiefly under the auspices of the Missouri Botanical Garden, have added greatly to our knowledge of the family Gesneriaceae. The plants of this family are exclusively tropical and often epiphytic. Until the last few years fewer than 20 species have been known from Panama. This number has been much more than doubled. There are known now over 30 species of *Columnea* alone, more than are recorded from Costa Rica, formerly considered one of the richest regions for Gesneriaceae. Almost all the novelties belong to the subfamily Columneoideae, which reaches its greatest development in Colombia.

The greatest number of new species have been discovered by Mr. Paul H. Allen, an exceedingly discerning collector, with an unusual faculty for picking out interesting and rare plants. Most of his recent collections have come from a locality cited as "hills north of El Valle de Anton, Province of Coel , altitude 1000 meters." This locality is described by Mr. Allen in a letter dated Feb. 2, 1941, as follows:

"About a week ago I had the opportunity of spending four days in El Valle, in Coel  Province, and I am astonished at the tremendous wealth of the place. This time I was able to get up into the high plateau regions to the north, and never in all my collecting experience have I seen such a fantastic region or such fascinating plants. After leaving the crater proper, there is a line of buffer hills to the north, rising in three rounded domes topped with an elfin forest and over which a steady cascade of fog and misty rain pours. To the north of these hills is a maze of valleys, with a most curious set of plateaus, some not over an acre or two and others probably forty or more acres. The tops are almost perfectly flat, with deep rich black soil, supporting a growth of giant trees which literally drip with epiphytes of all descriptions. There are almost always practically sheer drops on nearly all sides of these places, sometimes going down for several hundred feet. This last time there I came to such a precipice and could look down six or seven hundred feet below to where the tumbled hills and interlocking valleys ran off to the north. Occasionally the mists would clear for a bit, and far off the Atlantic Ocean could be seen. . . . I think I can guarantee that you will get some interesting plants."

Mr. Allen was quite right. On this trip, as on several later ones, he found many new and interesting plants, especially in the Ges-

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neriaceae. The affinity of the flora of this region is decidedly with the mountain flora of Costa Rica.

In addition to the plants collected by Mr. Allen, I have had the advantage of studying collections made by Dr. Robert E. Woodson, Jr. and Mr. R. W. Schery. These include several novelties, here described. A small, but very interesting collection, made by Mr. and Mrs. Terry in the mountains of the Province of Darien, was kindly made available by the Field Museum of Natural History.

The present paper lists only new species and new records. A complete account of the Gesneriaceae of Panama will be published at a later date.

ALLOPLECTUS CORIACEUS (Oerst.) Hanst. *Linnaea* **34**: 363. 1865-66.—BOCAS DEL TORO: Cricamola, region of Almirante, Jan.-March, 1928, *Cooper* 207. Distributed as *Drymonia* sp. Previously known from Costa Rica.

ALLOPLECTUS ICHTHYODERMA var. *PALLIDUS* Morton, *Field Mus. Publ. Bot.* **18**: 1145. 1938.—CHIRIQUÍ: Casita Alta to Cerro Copete, alt. 2300-3300 m., July 10, 1940, *Woodson & Schery* 359. Previously known from Costa Rica.

ALLOPLECTUS panamensis Morton, sp. nov. Herba lignosa, 1 m. alta; caules non ramosi, crassi, usque ad 12 mm. diam., apice ca. 5 mm. diam., tetragoni, lateraliter compressi, dense flavo-subhirsuti; folia per paria aequalia, longe petiolata, petiolo 5-11 cm. longo, hirsuto; lamina foliorum ovata 21-23 cm. longa, 12.5-15 cm. lata, breviter acuminata, basi rotundata, aequalis, chartacea, serrulata, supra viridis, pilosa, subtus pallidior, non rubro-maculata, ubique dense pilosa, venis lateralibus ca. 8-jugis, supra subobscuris; inflorescentia axillaris, densiflora, bracteis rubris, ovatis, ca. 1.5 cm. longis, acuminatis, denticulatis, pilosis, pedicellis 2-3 cm. longis, dense hirsutis; calyx ruber, lobis subaequalibus, oblongis, ca. 2.5 cm. longis, 1 cm. latis, acutis, herbaceis, glanduloso-serratis (denticibus ca. 11 utroque latere), externe dense flavo-hirsutis, intus strigosis; corolla coccinea, 4.5-5 cm. longa, in calyce obliqua, basi calcarata (4 mm.), tubo ca. 4 mm. diam. supra basim, sursum gradatim ampliato, non ventricosus, externe dense hirsuto, intus glabro, fauce 1 cm. lato, obliquo, limbo ca. 1.5 cm. lato, obliquo, lobis recurvis, subaequalibus, suborbiculatis, ca. 4 mm. longis, subintegris, intus glabris; filamenta basi vix in tubum connata, im corolla alte adnata, glabra; antherae inclusae, cohaerentes, transverse oblongae,

ca. 2 mm. longae, 3 mm. latae; ovarium hirsutum; stylus glaber; stigma bilobum; disci glandula postica solum evoluta, magna, crassa, glabra, emarginata.—COCLÉ: hills north of El Valle de Anton, alt. 1000 m., July 14, 1940, *Paul H. Allen 2189* (U. S. Nat. Herb., no. 1,791,876-7, TYPE); same locality June 23, 1940, *Allen 2166*.

On Cerro Campana in the Province of Panamá a related species has been collected (*Allen 2412*), which at first I considered the same. However, I am sure now that it is different, but the material lacks corollas and is insufficient for a description.

Alloplectus panamensis belongs to the section Glossoloma, but is not closely related to the other North American species, *A. tetragonus* and *A. simulatus*, which have appressed pubescence on stems and leaves. They have, also, cuneate-based leaves, those of *A. panamensis* being much broader and rounded-truncate at base.

ALLOPLECTUS simulatus Morton, sp. nov. Herba 1-2 m. alta; caules non ramosi, tetragoni, apice ca. 3 mm. diam., appressopuberuli; folia per paria aequalia, longe petiolata, petiolo 5.5-6 cm. longo, puberulo; lamina foliorum late elliptica, 14-17 cm. longa, 6-7.5 cm. lata, acuminata, basi late cuneata, paullo obliqua, subherbacea, serrulata, utrinque viridis et sparse puberula, pilis flavidis, flaccidis, paucicellularibus, venis lateralibus ca. 9-jugis; inflorescentia axillaris, pauciflora, bracteis deciduis, pedicellis 2-3 cm. longis, hirsutis; calyx rubro-aurantiacus, lobis subaequalibus, ovatis, 2.5-2.7 cm. longis, acutis, argute serratis, externe hirsutis, praecipue in linea mediali; corolla externe rubro-aurantiaca, intus lutea, ca. 5 cm. longa, in calyce obliqua, tubo faucem versus ampliato, densissime hirsuto, limbo valde obliquo, ca. 1.7 cm. lato, lobis subaequalibus, recurvis, intus glabris.—CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *R. E. Woodson & R. W. Schery 537* (U. S. Nat. Herb., no. 1,808,045, TYPE).

Closely related to *A. tetragonus* of Costa Rica, but differing in pubescence. In *A. tetragonus* the pubescence of the stems and lower leaf surface is closely appressed, but in *A. simulatus* the hairs are not appressed, but tortuous, very short and few-celled. In the Gesneriaceae, as a whole, the character of the hairs is very constant within the species, so this character alone would be sufficient to separate these two species. There are other differences also. The calyx of *A. simulatus* is larger and broader, the corolla more densely hirsute and the limb broader.

BESLERIA Allenii Morton, sp. nov. Frutex 1-1.5 m. altus; caules non ramosi, teretes, graciles, ca. 3 mm. diam., apicem versus 1 mm. diam., dense et breviter puberuli; folia per paria aequalia, petiolata, petiolo 0.8-4 cm. longo, gracili, puberulo; lamina foliorum oblonga, 7-13 cm. longa, 3-4.7 cm. lata, acuminata, basi late cuneata, paullo obliqua, membranacea, irregulariter serrata, supra atroviridis, glabra, subtus pallidior, praecipue in venis strigosa, venis lateralibus 10- vel 11-jugis subtus prominulis; inflorescentia axillaris, umbellata, 3- vel 4-flora, pedunculo communi ca. 2.5 cm. longo, parce pilosulo, pedicellis ca. 12 mm. longis; calyx viridis, lobis paullo inaequalibus, lobo postico ovato, reflexo, ca. 1.4 cm. longo, 7 mm. lato, lateralibus ovato-lanceolatis, obliquis, ca. 15 mm. longis et 6 mm. latis, anticis lanceolatis, ca. 15 mm. longis et 5 mm. latis, omnibus longe et acriter acuminatis, argute serratis, externe hirsutis, intus glanduloso-pilosulis; corolla flava, 3.5-4 cm. longa, in calyce horizontalis, basi postice calcarata (7 mm.), tubo basi ca. 5 mm. diam., sursum valde ventricosus, faucem versus non contracto, 1.8-2 cm. lato, externe glanduloso-pilosulo, intus glabro, limbo magno, terminali, bilabiato, lobis latis, rotundatis, intus glabris; filamenta glabra; antherae inclusae, cohaerentes, ca. 1.5 mm. longae et 2 mm. latae, loculis confluentibus; ovarium pilosulum; stylus pilosulus; stigma bilobum; discus annularis, antice evanescens, postice magnus, crassus, puberulus.—COCLÉ: vicinity of La Mesa, north of El Valle de Anton, alt. 1000 m., May 12, 1941, *Paul H. Allen 2371* (U. S. Nat. Herb., no. 1,793,964, TYPE).

This species belongs to section *Neobesleria* subsect. *Wendlandianae*. From *Besleria Wendlandiana* Hanst., of Costa Rica and Panama, it differs in the strongly ventricose, very broad corolla. From *B. columbiana* Morton it differs in the shorter peduncle and longer pedicels, the much larger calyx lobes, and the much larger and broader corolla.

BESLERIA ALLENII var. **paucivenia** Morton, var. nov. A var. *typica* venis lateralibus paucioribus (7- vel 8-jugis), inflorescentia uniflora, pedunculo communi brevi (1-1.5 cm. longo), pedicellis longioribus (1.5-2 cm. longis) differt.—COCLÉ: hills north of El Valle de Anton, alt. 1000 m., July 14, 1941, *Paul H. Allen 2188* (U. S. Nat. Herb., no. 1,806,127, TYPE).

BESLERIA BARBENSIS var. **hirsuta** Morton, var. nov. Herba 1 m. alta; caules non ramosi, ca. 3 mm. diam., apicem versus ca. 2 mm.

diam., hirsuti; folia per paria aequalia, petiolata, petiolo 2–3 cm. longo, gracili, hirsuto; lamina foliorum elliptica, 8–12 cm. longa, 4–5.5 cm. lata, breviter acuminata, basi cuneata, aequalis, herbacea, inconspicue serrulata, supra viridis, subtus pallidior, utrinque hirsuta, venis lateralibus 11- vel 12-jugis, subtus prominulis; inflorescentia axillaris, uniflora, pedunculo communi nullo, bracteis nullis, pedicello 3–3.5 cm. longo, gracili, hirsuto; calycis lobi virides, fere liberi, paullo inaequales, lobo postico ovato, ca. 12 mm. longo et 7 mm. basi lato, alteris oblongis, ca. 13 mm. longis, 5 mm. latis, omnibus acutis, argute serratis (dentibus subulatis, apice glandulosis), externe hirsutis, intus glabris; corolla aurantiaca, ca. 2 cm. longa, in calyce erecta, basi vix saccata, tubo supra basim ca. 4.5 mm. lato, sursum paullo ventricosum et 7 mm. lato, externe apice hirsuto, intus lineam horizontalem sparse pilosam gerente, limbo satis magno, ca. 12 mm. lato, terminali, bilabiato, lobis orbiculatis, patentibus, ca. 5 mm. longis et 7 mm. latis, rotundatis, subintegris, externe pilosis, intus glabris; filamenta glabra; antherae cohaerentes, inclusae, quadratae, ca. 1.5 mm. longae et 2 mm. latae, loculis confluentibus; ovarium apice pilosum; stylus pilosulus; stigma bilobum; discus annularis, integer, glaber, brevis, crassus.—CHIRIQUÍ: on the trail from Cerro Punta to headwaters of Rio Caldera, alt. 2250–2500 m., Jan. 14, 1939, *Paul H. Allen 1449* (U. S. Nat. Herb., no. 1,749,713, TYPE).

BESLERIA crassicaulis Morton, sp. nov. Herba 1.5–2.1 m. alta; caules crassissimi, non ramosi, ca. 11 mm. diam., apice ca. 9 mm. diam., teretes, densissime flavo-sericei; folia per paria aequalia, petiolata, petiolo 4–4.5 cm. longo, crassissimo, 5–9 mm. diam., densissime flavo-sericeo; lamina foliorum oblonga, magna, plus quam 30 cm. longa, 10 cm. lata, abrupte et breviter acuminata, basi obtusa vel late cuneata, subaequalis, integra, subcoriacea, supra viridis, glabra, subtus pallidior, praecipue in nervo mediali et venis primariis sericeo-strigosa, venis lateralibus verisimiliter ca. 12-jugis; inflorescentia axillaris, multiflora, pedunculo communi obsoleto, pedicellis numerosissimis, 12–15 mm. longis, gracilibus, subhirsutis; calycis lobi orbiculares, 5 mm. longi, 4 mm. lati, herbacei, rotundati, non mucronati, venosi, integri, externe praecipue basim versus subhirsuti, intus glabri, margine valde ciliati; corolla coccinea, ca. 17 mm. longa, in calyce paullo obliqua, basi saccata, tubo supra basim 4 mm. diam., sursum non ventricosum, 5 mm. diam., in fauce non contracto, externe glabro, intus glabro, limbo terminali,

subregulari, ca. 6 mm. lato, lobis suborbiculatis, ca. 2.5 mm. longis, subintegris, rotundatis, utrinque glabris; filamenta glabra; antherae loculi parvi, ca. 0.8 mm. longi, confluentes; ovarium fere glabrum, apice breviter pilosulum; stylus sparse pilosulus; stigma bilobum; discus annularis, glaber, brevis.—DARIEN: Cana-Cuasi Trail, Chepigana District, alt. 600 m., Mar. 12, 1940, *M. E. & R. A. Terry 1534* (Herb. Field Mus., no. 1,035,994, TYPE).

A species recalling the Colombian *Besleria maxima* Morton and *B. tambensis* Morton in its large leaves, very thick, densely hairy stem, and congested inflorescences. However, *B. crassicaulis* is probably not closely allied to either, but rather to *B. notabilis* Morton of Costa Rica, which has smaller, oblong calyx lobes only 3 mm. long and 1.5 mm. wide, and a smaller unspurred corolla.

BESLERIA obliqua Morton, sp. nov. Frutex 2 m. altus; caules ramosi, teretes, ca. 5 mm. diam., apicem versus ca. 2 mm. diam., breviter et dense scabro-pilosuli; folia per paria subaequalia, petiolo 1–2 cm. longo, scabro-pilosulo; lamina foliorum lanceolata, 4–7 cm. longa, 1.2–2.1 cm. lata, acuminata, basi cuneata, subaequalis, integra, chartacea, supra viridis, scabra (pilis patulis, basi valde inflatis), subtus pallidior, ubique pilosula, venis lateralibus 6-jugis; inflorescentia axillaris, pauciflora, pedunculo communi obsoleto, pedicellis ca. 5 mm. longis, pilosulis; calyx viridis, quam corolla multo brevior, lobis ovatis, paullo inaequalibus, postico ca. 2.5 mm. longo et lato, alteris ca. 3 mm. longis et 2 mm. latis, omnibus fere liberis, obtusis, non mucronatis, non venosis, externe pilosulis, intus glabris; corolla aurantiaca, ca. 17 mm. longa, in calyce subhorizontalis, basi subcalcarata (2 mm.), tubo supra basim ca. 4 mm. diam., sursum tubuloso, non ventricoso, externe sparse pilosulo, intus basi glabro, sursum glanduloso-pilosulo, in fauce non vel vix contracto, ca. 5 mm. lato, limbo terminali, ca. 7 mm. lato, lobis suborbiculatis, subaequalibus, ca. 3 mm. longis et latis, utrinque glabris, integris, rotundatis; filamenta basi in tubum antice ca. 3 mm. longum connata, glabra, partibus liberis brevibus, ca. 4 mm. longis, glabris; antherae liberae, inclusae, parvae, ca. 0.7 mm. longae, loculis divergentibus, apice confluentibus; staminodium magnum, ca. 4 mm. longum, antheram sterilem gerens; ovarium pilosulum; stylus pilosulus, brevis; stigma paullo bilobum; discus annularis, glaber, antice brevior.—COCLÉ: vicinity of La Mesa, north of El Valle de Anton, alt. 1000 m., May 12, 1941, *Paul H. Allen 2396* (U. S. Nat. Herb., no. 1,793,974, TYPE).

This species is most closely related, perhaps, to *B. miniata* Morton, and, like that, will key out to section *Neobesleria* subsect. *Axillares* in my "Revision of *Besleria*."¹ I think, however, that these two species, and perhaps also *B. flava* Morton, are best referred to *Eubesleria* sect. *Sessiles*. From *B. miniata* of Ecuador the present species differs strongly in pubescence, the leaves in that species being glabrous above and merely strigillose on the veins beneath. In *B. obliqua* the leaves are densely scabro-pilose above, the hairs being very strongly inflated at base, and are spreading-pilous all over the lower surface.

The only Central American species with which *B. obliqua* could be confused is *B. solanoides* H.B.K., but that also has leaves nearly glabrous above and merely strigose beneath, and the corolla is erect and not horizontal in the calyx.

CAMPANEA CHIRIQUANA Morton, Ann. Mo. Bot. Gard. 26: 310. 1939.—CHIRIQUÍ: Valley of Río Chiriquí Viejo, near Monte Lirio, Apr. 3, 1938, *Gene White* 62. Previously known only from the type.

CAMPANEA HUMBOLDTII (Kl.) Oerst. Centralamer. Gesner. 34. 1858.—CHIRIQUÍ: Valley of Upper Río Chiriquí Viejo, alt. 1300–1900 m., July 17, 1937, *Peggy & Gene White* 20; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery* 656. Originally collected in Veraguas, Panama, but not again collected in Panama until recently.

CENTROSOLENTIA *lineata* Morton, sp. nov. Herba epiphytica, subcaulis; caudex brevis, crassissimus, ramosus, albidus, glaber; folia petiolata, numerosa, conferta, petiolo usque ad 5 cm. longo, crassissimo, basi parce pilosulo, sursum glabro; lamina foliorum suboblanceolata, 14–24 cm. longa, 3.8–6.8 cm. lata, apice longe acuminata, basi longe cuneata, decurrens, remote denticulata, supra viridis, subtus siccitate brunnea, utrinque glaberrima, venis lateralibus 9-jugis, venis secundariis obscuris; flores axillares, fasciculati, numerosi, pedicellis 6–12 mm. longis, gracilibus, glabris; calycis lobi rubro-brunnei, liberi, subulati, filiformi-attenuati, basi 1.5–2 mm. lati, medio 0.2–0.5 mm. lati, inaequales, anteriores ca. 18 mm. longi, posticus reflexus, ca. 13 mm. longus, omnes externe parce strigillosi, apicem versus ciliati; corolla alba, externe et intus rubro-brunneo-lineata, 4 cm. longa, in calyce horizontalis, basi calcarata (2 mm.), tubo basi ca. 3 mm. diam., gradatim ampliato, subinfundi-

¹ Contr. U. S. Nat. Herb. 26: 404. 1939.

buliformi, non ventricoso, in fauce non contracto, ca. 15 mm. lato, externe glabro, intus glanduloso-pilosulo, limbo bilabiato, ca. 2 cm. lato, lobis albis, patentibus, lobo antico majore, orbiculato, ca. 1 cm. longo, rotundato, externe glabro, intus valde pilosulo, glanduloso-ciliato, lobis alteris subaequalibus, minoribus, ca. 5 mm. longis, utrinque glabris, glanduloso-ciliatis; filamenta basi im corollae tubo adnata, per paria connata, glabra, apice incurva; antherae glabrae, non barbatae, inclusae, connatae, subquadratae, ca. 1.2 mm. longae et 1.5 mm. latae, connectivo crasso, loculis discretis, divergentibus; ovarium pilosum; stylus crassus, glanduloso-pilosulus; stigma stomatomorphum; disci glandula postica solum evoluta, magna, crassa, glabra, integra.—COCLÉ: hills on trail to La Mesa, north of El Valle de Anton, alt. 1000 m., Aug. 31, 1941, *Paul H. Allen 2717* (U. S. Nat. Herb., no. 1,821,127, TYPE).

In habit somewhat similar to *Centrosolenia decurrens* Morton, of Costa Rica, which may be distinguished by the following key. The genus *Centrosolenia* is new to Panama.

Corolla tube ventricose at middle; anthers bearded at apex; leaves strigose on both surfaces, hirsute on veins beneath.....*C. decurrens*
Corolla tube infundibuliform, gradually widened to throat; anthers glabrous; leaves entirely glabrous.....*C. lineata*

COLUMNEA Allenii Morton, sp. nov. Planta epiphytica, pendens; caules vix ramosi, graciles, ca. 1.5 mm. diam., parce strigosi; folia aequalia, breviter petiolata, petiolo ca. 3 mm. longo, strigoso; lamina foliorum oblongo-elliptica, usque ad 2 cm. longa et 1.1 cm. lata, breviter acuminata, basi rotundata, haud obliqua, integra, crassa, utrinque glabra, venis utrinque immersis, obscuris; flores axillares, solitarii, ebracteati, pedunculo 1.7–2 cm. longo, rubro-strigoso, pilis multicellularibus, flaccidis; calyx erectus, rubro-tinctus, lobis paullo inaequalibus, 2.2–3 cm. longis, ca. 1 cm. basim versus latis, longe et acriter acuminatis, integris, externe vix strigillosis, ciliatis, intus basim versus longe hirsutis; corolla coccinea, in calyce erecta, 6.8–7.5 cm. longa, basi subcalcarata (3 mm.), tubo calycem aequante, supra basim 4 mm. diam., sursum ampliata, fauce ca. 15 mm. lato, externe parce piloso, limbo valde bilabiato, galea 4–4.5 cm. longa, ca. 2.5 cm. lata, apice truncata, lobis lateralibus cum galea alte connatis, ca. 14 mm. longis, lobo inferiore reflexo, oblongo-ob lanceolato, 2.7–3 cm. longo, 7–8 mm. lato; filamenta basi in tubum 4 mm. longum postice fissum connata, glabra; antherae exsertae, per paria connatae, oblongae, ca. 3 mm. longae, 1 mm. latae; ovarium

albo-pilosum; stylus pilosulus; stigma bilobum.—COCLÉ: hills north of El Valle de Anton, alt. 1000 m., June 23, 1940, *Paul H. Allen*, 2179 (U. S. Nat. Herb., nos. 1,791,874-5, TYPE).

COLUMNEA arguta Morton, sp. nov. Planta epiphytica; caules pendentes, elongati, graciles, ca. 1.5 mm. diam., hornotini rubro-hispidi, pilis rigidis, patentibus; folia aequalia, brevissime petiolata, petiolo ca. 1 mm. longo, hispido; lamina foliorum lanceolata, 1.6-2 cm. longa, 6-7 mm. lata, longe acuminata, basi rotundata, paullo obliqua, exauriculata, non amplexicaulis, crassa, integra, utrinque glabra, margine ciliata excepta, supra viridis, subtus rubescens, venis lateralibus 1- vel 2-jugis, obscuris; flores verisimiliter solitarii, breve pedunculati, pedunculo crasso, hispido; calyx erectus, lobis subaequalibus, ca. 15 mm. longis, 9 mm. latis (dentibus inclusis), utrinque hirsutis, laciniatis (dentibus elongatis, usque ad 3 mm. longis et 1 mm. latis, ca. 5 utroque latere); corolla in calyce erecta, rubra, fauce luteo-lineata, ca. 6 cm. longa, basi subcalcarata (3 mm.), tubo supra basim 4 mm. diam., sursum paullo ampliato, ca. 1 cm. lato, externe sparse piloso, intus basi glanduloso, limbo bilabiato, intus glabro, galea 2 cm. longa, apice truncata, latissima, ca. 2.7 cm. lata, lobis lateralibus magnis, ca. 13 mm. longis, lobo inferiore elliptico, reflexo, ca. 2 cm. longo et 1.1 cm. lato, rotundato; filamenta in tubum 4 mm. longum postice fissum connata, glandulosa, sursum glabra; antherae ignotae; ovarium sericeum; stylus sparse pilosulus; stigma truncatum; disci glandula postica solum evoluta, glabra, crassa, bidenticulata.—COCLÉ: hills north of El Valle de Anton, vicinity of La Mesa, alt. 1000 m., Jan. 21, 1941, *Paul H. Allen* 2336 (U. S. Nat. Herb., no. 1,806,120, TYPE).

The form of the corolla is unusual in the subgenus *Eucolumnea*. The galea is short and very broad, the lateral lobes large, and the lower lobes very much broader than in the other species. The corolla approaches that of section *Pentadenia*, but it is not ventricose or curved. It differs also from the Panama species of *Pentadenia* in its glabrous leaves.

The closest relationship is apparently with *Columnea flaccida* Seem. (Bot. Voy. Herald 186. 1852-57), originally described from near Gualaca, Veraguas, Panama, which has been collected a few times in Costa Rica but not since found in Panama. It is a pendent epiphyte, flowering while leafless, with stems sparingly strigose (rather than coarsely hispid as in *C. arguta*), and corolla with a shape characteristic of *Eucolumnea*.

COLUMNEA citrina Morton, sp. nov. Planta terrestris; caulis ca. 60 cm. longus, non ramosus, basi ca. 8 mm. diam., apice 3 mm. diam., juventute strigosus; folia per paria valde inaequalia, majora oblongo-lineararia, 20–25 cm. longa et 5 cm. lata, falcata, sessilia, longe acuminata, basi inferiore auriculata, semiamplexicaulia, superiore cuneata, crassa, supra glabra, viridia, subtus substrigosa, pallidiora, ca. 6 cm. infra apicem maculam rubram ca. 8 mm. longam gerentia; folia minora stipuliformia, sessilia, lineari-lanceolata, ca. 2 cm. longa et 5 mm. lata, longe acuminata, basi valde obliqua, basi inferiore auriculata et amplexicaulia, superiore rotundata; inflorescentia axillaris, biflora, bibracteata, bracteis flavis, basalibus, lineari-lanceolatis, ca. 1.5 cm. longis et 5 mm. latis, longe acuminatis, externe strigosis, intus glabris, pedunculis crassis, 1–1.5 cm. longis, dense strigosis; calyx pallide viridi-luteus, in anthesin ca. 3 cm. longus, demum 3.8 cm. longus, lobis aequalibus, erectis, lanceolatis, liberis, ca. 12 mm. latis, longe et acriter acuminatis, integris, externe substrigosis, intus glabris, linea mediali excepta; corolla lutea, intus roseo-lineata, ca. 4.7 cm. longa, in calyce erecta, basi subcalcarata (ca. 2 mm.), tubo 3 mm. super basi 5 mm. diam., sursum ventricosus et 1 cm. diam., apicem versus paullo contracto, fauce tubuloso, externe valde hirsuto, limbo valde bilabiato, fauce et lobis intus glabris, galea 2.5 cm. longa, apice alte biloba (ca. 7 mm.), lobis lateralibus cum galea alte connatis, ca. 12 mm. longis, lobo inferiore reflexo, lineari-oblongo, 18 mm. longo, 5 mm. lato; filamenta basi in tubum 4 mm. longum connata, glabra; antherae exsertae, 3 mm. longae et 2.5 mm. latae; staminodium subulatum, 3 mm. longum; ovarium dense albo-sericeum; stylus glaber; stigma stomatomorphum; disci glandula postica solum evoluta, magna, crassa, glabra, subintegra; placentae lamellae intus solum ovuliferae.—**PANAMÁ:** Cerro Campana, alt. 1000 m., April 21, 1941, *Paul H. Allen* 2404 (U. S. Nat. Herb., nos. 1,793,913–4, TYPE).

For discussion, see under *C. rubra*.

COLUMNEA conferta Morton, sp. nov. Frutex epiphyticus, 0.6–1.2 m. altus; caules non ramosi, crassi, ca. 7 mm. diam., strigosi, mox glabri; folia apice conferta, per paria valde inaequalia, subsessilia, petiolo usque ad 4 mm. longo, crasso, strigoso; lamina foliorum majorum oblanceolata, subfalcata, 28–32 cm. longa, 6.5–7 cm. lata, apice breviter acuminata, basi valde obliqua, non amplexicaulis, chartacea, remote serrulata, supra viridis, glabra, subtus sparse strigosa, ca. 7 cm. infra apicem maculas 2 rubras gerens, venis

lateralibus 10–12-jugis; folia minora stipuliformia, decidua; inflorescentia axillaris, pauciflora, bracteis linearibus, ca. 2.5 cm. longis, 8 mm. latis, longe acuminatis, breviter petiolatis, integris, viridibus, pedunculis ca. 9 mm. longis, dense strigosis; calycis lobi pallidi, subaequales, ovati, ca. 2.3 cm. longi, basim versus ca. 1 cm. lati, longe et acriter acuminati, glanduloso-serrati (dentibus minutis ca. 10 utroque latere), externe substrigosi, intus fere glabri; corolla lutea, intus postice rubro-lineata, ca. 4 cm. longa, in calyce erecta, basi parum saccata, tubo supra basim paullo contracto et 3 mm. diam., sursum ampliato, non ventricosus, ca. 9 mm. diam., externe sparse glanduloso-pilosus, intus glabro, fauce vix contracto, limbo obliquo, verisimiliter paullo bilabiato, lobis subaequalibus, ca. 6 mm. longis, intus glabris; filamenta basi in tubum 3.2 mm. longum postice fissum connata, glabra; antherae inclusae, cohaerentes, quadratae, ca. 1.8 mm. longae et latae; ovarium sparse pilosum; stylus glaber; stigma stomatomorphum, glabrum; disci glandula postica solum evoluta, magna, crassa, glabra, non denticulata.—DARIEN: in rain forest, on crest of Cana-Cuasi Trail, Chepigana District, alt. 1650 m., Mar. 15, 1940, *M. E. & R. A. Terry 1554* (Herb. Field Mus., no. 1,035,985, TYPE).

Perhaps related to *Columnnea crassa*, but the leaves are larger and much thinner, the stems are not densely hirsute, but strigose or glabrate, and the calyx lobes are not hirsute.

COLUMNNEA CONSANGUINEA Hanst. *Linnaea* 34: 383. 1865–66.—CHIRIQUÍ: Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 651*. Previously known from Costa Rica.

COLUMNNEA crassa Morton, sp. nov. Planta epiphytica; caules erecti, crassi, 75 cm. longi, ca. 1 cm. diam., apice paullo angustiores, dense brunneo-hirsuti, pilis tenuibus, patentibus, multicellularibus; folia per paria inaequalia, petiolata, petiolo ca. 8 mm. longo, crassissimo, dense hirsuto; lamina foliorum majorum anguste oblanceolata, subfalcata, integra, usque ad 21 cm. longa et 5 cm. lata, longe acuminata, basi valde obliqua, crassa, supra viridis, glabra, subtus viridis, maculas rubras (saepe 2) 5–6 cm. infra apicem gerens, ubique subdense flavo-strigosa, venis primariis ca. 8-jugis; folia minora stipuliformia, sessilia, anguste lanceolata, ca. 2.5 cm. longa, ca. 8 mm. lata, basi inferiore auriculata et amplexicaulia, viridia, supra glabra, subtus strigosa; inflorescentia axillaris, uniflora?, floribus sessilibus; calyx flavus?, lobis erectis, paullo inaequalibus,

1.6–2 cm. longis, 4–7 mm. latis, glanduloso-serratis (dentibus numerosis), acuminatis, externe appresso-hirsutis, intus subglabris, linea mediali subhirsutis; corolla ignota; disci glandula postica solum evoluta; placentae lamellae intus solum ovuliferae.—PANAMÁ: Cerro Campana, alt. 1000 m., Apr. 21, 1941, *Paul H. Allen 2423* (U. S. Nat. Herb., nos. 1,793,929–30, TYPE).

Related to *C. consanguinea* Hanst. (*Linnaea* 34: 383. 1865–6), of the section *Collandra*, which may be distinguished as follows:

Leaves lacking red spots beneath; calyx lobes entire.....*C. consanguinea*
 Leaves with 2 or more red spots beneath about a third from the apex; calyx lobes serrate.....*C. crassa*

COLUMNEA darienensis Morton, sp. nov. Frutex, 1.5–4.5 m. altus; caules vix ramosi, articulati, internodiis brevibus, dense strigosi, apice ca. 3 mm. diam.; folia per paria valde inaequalia, majora petiolata, petiolo 10–14 mm. longo, strigoso; lamina foliorum majorum oblanceolata, 16–23 cm. longa, 4–5.5 cm. lata, acuminata, basi obliqua, late cuneata, non amplexicaulis, integra, chartacea, supra viridis, glabra, subtus pallidior, non rubro-maculata, strigosa (praecipue in venis), venis lateralibus 7-jugis, supra obscuris; folia minora stipuliformia, minuta, decidua, lanceolata, acuminata, supra glabra, subtus strigosa; inflorescentia axillaris, pauciflora, bracteis basalibus ovatis, ca. 1.7 cm. longis, integris, acuminatis, fortasse rubris, pedicellis ca. 5 mm. longis, crassis, strigosis; calyx verisimiliter ruber, lobis subaequalibus, lanceolatis, ca. 1.7 cm. longis, 5 mm. latis, acuminatis, glanduloso-serrulatis (dentibus ca. 7 utroque latere), externe nervo mediali et marginibus strigosis, intus glabris; corolla coccineo-aurantiaca, 2.4 cm. longa, in calyce erecta, tubulosa, tubo basi ca. 3 mm. diam., sursum paullo ventricoso et 5 mm. lato, faucem versus paullo contracto et 4.5 mm. lato, externe dense flavo-strigoso, limbo parvo, vix bilabiato, ca. 5 mm. lato, lobis erectis, suborbiculatis, rotundatis, 3 inferioribus ca. 1 mm. longis, 2 superioribus ca. 2 mm. longis, altius connatis; filamenta basi in tubum brevem connata, glabra; antherae quadratae, ca. 1.5 mm. longae et latae; ovarium apice strigosum; stylus glaber; disci glandula postica solum evoluta, crassa, glabra, tridenticulata.—DARIEN: Cerro de Garagará, Sambú Basin, alt. 500–974 m., Feb. 7, 1912, *H. Pittier 5660* (U. S. Nat. Herb., no. 715,942, TYPE); rain forest on the crest of the Cana-Cuasi Trail, Chepigana District, alt. 1650 m., Mar. 13, 1940, *M. E. & R. A. Terry 1547* (Herb. Field Mus.).

From *Columnea crassa* this species differs in its much narrower

calyx lobes, strigose rather than hirsute stems, and absence of red spots on the lower leaf surface. It is probably more closely related to *C. consanguinea*, from which it differs in the serrate rather than entire calyx lobes, broader bracts, and absence of red spots on the leaves. *Columnnea conferta* has a differently shaped corolla limb with much larger, broader, more oblique lobes, as well as larger, thinner, differently shaped, red-spotted leaves.

COLUMNNEA dissimilis Morton, sp. nov. Planta epiphytica; rami usque ad 1 m. longi, internodiis brevibus, juniores rubri, hispidi, pilis patentibus, rubris, multicellularibus; folia per paria inaequalia, petiolata, petiolo 5–9 mm. longo, hispido; lamina foliorum majorum elliptico-oblonga, usque ad 7 cm. longa et 3 cm. lata, apice acuminata, basi valde obliqua (latere inferiore rotundato, superiore cuneato), integra, utrinque viridis, supra pilosula, subtus praecipue in venis rubro-hirsuta; folia minora saepe sessilia, ovata vel suborbicularia, acuta vel obtusa, basi rotundata, usque ad 3 cm. longa et 1.8 cm. lata; flores saepe 3 in axillis aggregati, pedunculati, pedunculo 1–1.7 cm. longo, dense longe rubro-hirsuto; calyx ruber, erectus, lobis aequalibus, liberis, lanceolatis, 2.5–3 cm. longis, acuminatis, remote glanduloso-denticulatis, herbaceis, utrinque rubro-hirsutis; corolla rubra, in calyce paullo obliqua, 3.5–4 cm. longa, basi postice subcalcarata, tubo basi 4 mm. lato, tubuloso, vix ampliato, non ventricosus, externe dense rubro-hirsuto, intus glabro, fauce 8 mm. lato, non contracto, lobis 5 aequalibus, incurvatis, ovatis, vix acutis, ca. 4.5 mm. longis, crassis, intus glabris, inter lobos appendiculata, appendiculis patentibus, lineari-subulatis, ca. 7 mm. longis, dense hirsutis; filamenta basi in tubum 4 mm. longum postice fissum connata, sursum libera, gracilia, glabra; antherae quadratae, ca. 2 mm. longae et latae; ovarium albo-pilosum; stylus gracilis, glaber; stigma bilobum; disci glandula postica solum evoluta, lata, crassa, glabra, tridenticulata.—COCLÉ: trail to Las Minas, north of El Valle de Anton, alt. 1000 m., May 10, 1941, *Paul H. Allen 2483* (U. S. Nat. Herb., no. 1,808,614, TYPE); same locality, June 23, 1940, *Allen 2164*, and July 14, 1940, *Allen 2191*; PANAMÁ: hills above Campana, alt. 600–800 m., July 1, 1939, *Allen 1875*.

COLUMNNEA hirsutissima Morton, sp. nov. Planta epiphytica; caules 13–30 cm. longi, non ramosi, crassi, perspicue rubro-hirsutissimi, pilis multicellularibus, ca. 5 mm. longis; folia per paria valde inaequalia, sessilia, petiolo crasso, 1–2 mm. longo, hirsuto;

lamina foliorum majorum oblonga vel anguste oblonga, 6–10 cm. longa, 1.7–3.5 cm. lata, acuta, basi rotundata vel subcordata, non obliqua, paullo crenulata vel serrulata, utrinque viridis, non rubromaculata, dense hirsuta, pilis rubescentibus, multicellularibus, 7–9-jugis; folia minora sessilia, ovata, ca. 1 cm. longa, decidua; flores solitarii, axillares, ebracteati, pedunculati, pedunculo 8–12 mm. longo, dense hirsuto; calyx erectus, lobis subaequalibus, 1.7–1.8 cm. longis, linearibus, ca. 2.5 mm. basim versus latis, longe acuminatis, remote glanduloso-denticulatis (dentibus 2 vel 3 utroque latere), utrinque hirsutis, pilis saepe rubris; corolla rubra, in calyce erecta, 6–7.5 cm. longa, basi subcalcarata, tubo supra basim ca. 4 mm. lato, sursum tubuloso et gradatim ampliato, non ventricosus, externe sparse pilosus (pilis multicellularibus non glandulosis), intus glanduloso, fauce ca. 8–9 mm. lato, limbo valde bilabiato, intus pilosulo, galea 2.3–2.5 cm. longa, apice truncata, 1.4 cm. lata, lobis lateralibus cum galea alte connatis, brevibus, ca. 6 mm. longis, lobo inferiore reflexo, lineari-oblongo, ca. 13 mm. longo, 3 mm. lato, obtuso; filamenta basi in tubum 4 mm. longum postice fissum connata, basim versus glandulosa, sursum glabra; antherae connatae, exsertae, oblongae, ca. 2 mm. longae, 1 mm. latae; ovarium albobilosum; stylus dense glanduloso-pilosulus; stigma bilobum; disci glandula postica solum evoluta, glabra, crassa, tridenticulata.—**COCLÉ:** hills north of El Valle de Anton, alt. 800–1000 m., Jan. 2, 1941, *Paul H. Allen 2288* (U. S. Nat. Herb., no. 1,806,116, **TYPE**); same locality, Nov. 21, 1940, *Allen 2279* (*Dorothy Allen*), Jan. 21, 1941, *Allen 2311* and *2348*.

For relationships, see under *C. rubra* below.

COLUMNEA incarnata Morton, sp. nov. Frutex epiphyticus; caules vix ramosi, sulcati, apice ca. 3 mm. diam., flavo-strigosi, demum glabrescentes; folia per paria subaequalia, petiolata, petiolo 1.3–2.3 cm. longo, strigoso; lamina foliorum oblanceolata, 7–12 cm. longa, 2.3–4 cm. lata, longe acuminata, basi aequalis, cuneata, integra, subcrassa, supra viridis, glabra, subtus pallidior, non rubromaculata, in margine et venis strigosa, venis lateralibus 4- vel 5-jugis, supra obscuris; inflorescentia axillaris, floribus solitariis vel binis, bracteis basalibus lineari-subulatis, ca. 7 mm. longis, basi ca. 1.5 mm. latis, acuminatis, intus glabris, externe strigosis, integris, pedicellis cernuis, 3–4 cm. longis, dense flavo-strigosis; calycis lobi virides, ovati, 3.3–3.5 cm. longi, ca. 1.5 cm. lati, longe et acriter acuminati, fere integri, remote glanduloso-denticulati, utrinque

glabri, parce ciliati; corolla incarnata, 6.5–7 cm. longa, in calyce erecta, basi subsaccata, tubo supra basim 5 mm. diam., abrupte ventricosus, ca. 2 cm. longo, in calyce incluso, externe puberulus, intus glandulosus, limbo curvato, valde obliquo, bilabiato, galea ca. 5 cm. longa, apice truncata, ca. 3.5 cm. lata, lobis lateralibus cum galea alte connatis, magnis, partibus liberis ca. 2.3 cm. longis, 1.3 cm. latis, rotundatis, lobo inferiore patente, magno, ca. 3 cm. longo et 1.1 cm. lato, lobis externe pilosis, intus glabris; filamenta basi in tubum 2 mm. longum postice fissum connata, dense glanduloso-puberula; antherae exsertae, cohaerentes, oblongae, 3 mm. longae et 1 mm. latae; ovarium albo-sericeum, apice pilosum; stylus glaber; stigma bilobum; disci glandula postica solum evoluta, magna, crassa, glabra, emarginata.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *R. E. Woodson & R. W. Schery 608* (Herb. Missouri Bot. Gard., TYPE).

This species belongs to the section *Pentadenia* and is perhaps related remotely to *C. magnifica*, which also has the disk reduced to a single posterior gland, in contrast to most of the other species of *Pentadenia*. It may be distinguished as follows:

Flowers pink; calyx glabrous, the lobes ciliate, subentire or remotely glandular-denticulate.....*C. incarnata*
Flowers bright scarlet; calyx villous, the lobes conspicuously dentate.....*C. magnifica*

COLUMNEA LOCALIS Morton, Field Mus. Publ. Bot. 18: 1165. 1938 (*Columnea microcalyx* var. *macrophylla* Donn. Smith, Bot. Gaz. 31: 118. 1901, non *C. macrophylla* Kuntze).—This species has been known only from the type, collected in forests of Las Vueltas, Tucurrique, Costa Rica. It may now be reported from: PANAMA: Cerro de Garagará, Sambú Basin, southern Darien, alt. 500–974 m., Feb. 7, 1912, *Pittier 5625*; and CHIRIQUÍ: trail from Cerro Punta to headwaters of Río Caldera, alt. 2250–2500 m., Jan. 14, 1939, *Allen 1428*.

In the 'Flora of Costa Rica' on page 1162, in the key to *Columnea*, the name *C. microphylla* is printed *C. macrophylla*, by an unfortunate typographical error.

COLUMNEA obliqua Morton, sp. nov. Planta epiphytica; caules elongati, pendentes, non ramosi, straminei, teretes, ca. 2.5 mm. diam., parce flavo-strigosi, mox glabri; folia opposita, aequalia, subsessilia, lanceolata, usque ad 3.5 cm. longa et 1.2 cm. lata, apice longe acuminata, basi valde obliqua, rotundata, integra, crassa, supra viridia, subtus pallidiora et rubescentia, supra glabra, subtus in margine et venis strigosa; flores solitarii, axillares, pedunculo 7–15

mm. longo, 1 mm. crasso, substrigoso, apice paullo incrassato; calyx viridis, 1.2–1.8 cm. longus, lobis erectis, aequalibus, liberis, basi ca. 6 mm. latis, subcordatis, gradatim angustatis, longissime et acriter acuminatis, integris, externe parce strigosis, intus glabris, basi pilosula excepta; corolla aurantiaca, 6.5–8 cm. longa, in calyce erecta, basi postice paullo calcarata (1.5 mm.), tubo 3.7 mm. diam., sursum parce ampliato, non ventricosus, fauce ca. 12 mm. lato, externe parce pilosulo, intus glabro, limbo valde obliquo, bilabiato, galea erecta, integra, 3.3–3.8 cm. longa, lobis lateralibus cum galea alte connatis, ca. 1.3 cm. longis, lobo inferiore reflexo, lineari-oblongo, 1.4–1.7 cm. longo; filamenta basi in tubum 2 mm. longum postice fissum connata, sursum omnino libera, didynama, glabra, antheris oblongis, 1.6 mm. longis et 1 mm. latis, per paria connatis; ovarium albo-sericeum; stylus gracilis, parce pilosulus; stigma bilobum; disci glandula postica lata, magna, emarginata, crassa, glabra, antica parva, lineari-subulata.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *R. E. Woodson, Jr. & R. W. Schery 607* (U. S. Nat. Herb., no. 1,808,050, TYPE); same locality and date, *Woodson & Schery 677*.

COLUMNEA PANAMENSIS Morton, Ann. Mo. Bot. Gard. 26: 312. 1939.—CHIRIQUÍ: vicinity of Finca Lérída, alt. 1750 m., July 7–11, 1940, *Woodson & Schery 235*. Previously known only from type.

COLUMNEA pectinata Morton, sp. nov. Planta epiphytica; caules pendentes, 100 cm. longi, rugosi, ca. 8 mm. diam., hornotini griseo-hirsuti; folia per paria inaequalia, subsessilia, petiolo vix 2 mm. longo, hirsuto; lamina foliorum majorum oblongo-falcata, usque ad 13 cm. longa et 5 cm. lata, abrupte acuminata, basi valde obliqua, basi inferiore subauriculata, crassa, apicem versus argute serrulata, supra viridis, hirsuta, subtus pallidior, apice sanguinea, ubique dense hirsuta, venis lateralibus 8–10-jugis; folia minora stipuliformia, sessilia, lanceolata, ca. 1.7 cm. longa, hirsuta, basi inferiore auriculata; inflorescentia axillaris, pluriflora, floribus breve pedunculatis, pedunculo crasso, ca. 5 mm. longo, hirsuto; calyx ruber, erectus, lobis subaequalibus, ca. 15 mm. longis, ca. 3 mm. latis, pectinato-fimbriatis (dentibus 5–6 utroque latere, subulatis, usque ad 4 mm. longis), utrinque dense hirsutis, pilis hyalinis, multicellularibus, capitato-glandulosis; corolla aurantiaca, in calyce erecta, e calyce vix exserta, ca. 1.7 cm. longa, basi subcalcarata, tubo supra basim ca. 4.5 mm. diam., sursum paullo ventricosus et 6.5 mm. diam., in fauce paullo contracto et 5 mm. diam., externe albo-piloso,

limbo regulari, haud bilabiato, 7 mm. lato, lobis patentibus, sub-orbiculatis, ca. 3 mm. longis, rotundatis, intus glabris; filamenta in tubum 5 mm. longum postice fissum connata, glabra, valde contorta; antherae inclusae, per paria cohaerentes, 1.5 mm. longae et 2 mm. latae; ovarium albo-sericeum; stylus crassus, glaber; stigma stomatomorphum; disci glandula postica solum evoluta, glabra, tridenticulata.—COCLÉ: vicinity of La Mesa, north of El Valle de Anton, alt. 1000 m., May 12, 1941, *Paul H. Allen 2394* (U. S. Nat. Herb., nos. 1,793,972-3, TYPE); same locality, June 23, 1940, *Allen 2177* and May 14, 1939, *Allen 1787*.

Related to *Columnnea purpurata* Hanst., which has larger leaves, not red beneath at apex, conspicuous bracts, and a larger calyx and corolla.

COLUMNNEA perpulchra Morton, sp. nov. Planta epiphytica; caules non ramosi, crassi, basi ca. 7 mm. diam., apicem versus ca. 2.5 mm. diam., densissime brunneo-hirsuti, pilis saepe 6 mm. longis; folia per paria valde inaequalia, subsessilia, petiolo vix 2 mm. longo; lamina foliorum majorum oblongo-oblanceolata, usque ad 16 cm. longa et 4.7 cm. lata, apice breviter et abrupte acuminata, basi valde obliqua sed non auriculata vel amplexicaulis, serrulata, herbacea, supra viridis, pilosa, subtus apice rubra, vel interdum ubique rubra vel rubro-maculata, hirsuta, venis lateralibus ca. 11-jugis, subtus prominulis; folia minora stipuliformia, sessilia, ovata, usque ad 2 cm. longa et 1 cm. lata, longe et acriter acuminata, basi valde obliqua, basi inferiore auriculata, subamplexicaulia, utrinque hirsuta, subtus apice rubra; inflorescentia biflora, axillaris, basi bibracteata, bracteis lanceolato-subulatis, ca. 7 mm. longis, integris, acuminatis, hirsutis, viridibus, pedicellis gracilibus, ca. 2 cm. longis, hirsutis; calyx pallidus, erectus, lobis subaequalibus, ca. 2 cm. longis, 3 mm. latis (dentibus exclusis), acuminatis, laciniatis (laciniis subulatis, usque ad 3 mm. longis, ca. 6 utroque latere), externe pilosis, intus glabris; corolla lutea (lobis basi coccineis), ca. 4 cm. longa, basi subcalcarata (3.5 mm.), tubo externe glaberrimo, intus glabro, supra basim contracto et 3.5 mm. diam., abrupte deflexo et ventricosus et ca. 8 mm. lato, faucem versus paullo contracto, fauce ca. 7 mm. lato, limbo subregulari, lobis reflexis, externe parce strigosis, lobis 2 superioribus ca. 2 mm. connatis, alteris liberis, suborbiculatis, rotundatis, omnibus ca. 5 mm. longis, intus glabris, eglandulosis; filamenta basi in tubum 8 mm. longum postice fissum connata, glabra, plus minusve contorta; antherae inclusae, connatae, quadratae, ca.

2 mm. longae et latae; ovarium fere glabrum; stylus glaber; stigma bilobum; disci glandula postica solum evoluta, glabra, crassa, emarginata.—COCLÉ: hills north of El Valle de Anton, vicinity of La Mesa, alt. 1000 m., Jan. 21, 1941, *Paul H. Allen 2305* (U. S. Nat. Herb., no. 1,806,117, TYPE); COLON: Dos Bocas, Río Fató Valley, alt. 40–80 m., Aug. 16, 1911, *H. Pittier 4209*. The related species *C. silvarum*, described below, may be distinguished as follows:

Corolla tube entirely glabrous; leaves red beneath at apex, or sometimes all over.

C. perpulchra

Corolla tube pilose externally, pilosulous at base within; leaves green, not at all red-spotted.

C. silvarum

COLUMNEA rubra Morton, sp. nov. Planta epiphytica; caulis stramineus, vix ramosus, strigosus, mox glaber; folia per paria inaequalia, majora brevissime petiolata, petiolo ca. 2 mm. longo, crasso, ca. 4 mm. diam.; lamina foliorum majorum anguste oblanceolata, usque ad 14 cm. longa et 4.7 cm. lata, acuta, basi subaequalis, rotundata, crassa, supra pallide viridis, glabra, subtus ubique rubra, strigosa, integra, nervo mediali valde incrassato, venis lateralibus ca. 8-jugis, supra obscuris, immersis, subtus prominulis; folia minora decidua; inflorescentia axillaris, biflora, bibracteata, bracteis lineari-lanceolatis, ca. 5 mm. longis, integris, externe rubro-strigosis, pedunculis ca. 1 cm. longis, dense rubro-strigosis; calyx ruber, ca. 1.9 cm. longus, lobis erectis, aequalibus, lineari-lanceolatis, ca. 5 mm. latis, longissime et acriter acuminatis, remote glanduloso-serratis (dentibus ca. 4 utroque latere), utrinque dense rubro-strigosis; corolla lutea, 7 cm. longa, in calyce erecta, basi subcalcarata (ca. 2 mm.), tubo supra basim 3 cm. lato, sursum gradatim ampliato, non ventricosus, fauce 11 mm. lato, externe piloso, pilis paucicellularibus, glanduloso-capitatis, galea 2.7 cm. longa, 1.4 cm. lata, integra, apice apiculata, lobis lateralibus ca. 1 cm. longis, cum galea longe connatis, lobo inferiore reflexo, lineari, 1.7 cm. longo, 4 mm. lato, lobis omnibus utrinque glanduloso-pilosulis; filamenta basi in tubum 5 mm. longum connata, glabra; antherae connatae, oblongae, ca. 2.2 mm. longae, 1.6 mm. latae; ovarium cylindricum, sericeum; stylus omnino glanduloso-pilosulus; stigma bilobum, glanduloso-pilosulum; disci glandula postica solum evoluta, glabra, crassa, integra.—COCLÉ: trail to Las Minas, north of El Valle de Anton, alt. 1000 m., May 10, 1941, *Paul H. Allen 2469* (U. S. Nat. Herb., no. 1,808,603, TYPE).

The above measurements for the corolla are taken from flowers preserved in liquid. In drying, the corollas contract a great deal.

The following measurements of dried corollas are given for comparison with herbarium specimens: Length 6–6.5 cm., tube above base 2 mm. broad, throat 7 mm. broad, galea 2.5 cm. long, ca. 7 mm. broad, lateral lobes ca. 7 mm. long, lower lobe ca. 1.4 cm. long.

The section *Cryptocolumnea* is a peculiar small one in which the corolla has the bilabiate shape of *Eucolumnea*, but the leaves are similar to those of *Collandra*. The only previously known North American species is *C. praetexta* Hanst. (Linnaea 34: 394. 1865–66), originally collected at an undesignated locality in Costa Rica by Warszewicz, which has never been found again. *Columnea citrina*, described above, is certainly a member of the section, and the present species, *C. rubra*, will probably be found to belong there also, the corolla being that of *Eucolumnea*, but the leaves, by their shape and red coloration, suggesting those of *Collandra*. However, the characteristic stipuliform leaves are lacking on the specimen at hand. Another very distinctive species, *C. hirsutissima*, is described above. These species may be separated as follows:

- Stigma stomatomorphic; calyx lobes entire or nearly so; bracts large (2 cm. long or more); leaves very oblique at base, with the lower side auriculate and amplexicaul, green beneath with a purple spot toward apex.
- Bracts orbicular, crenulate; leaves villous above; stipuliform leaves 2.5–5 cm. long.....*C. praetexta*
- Bracts lanceolate, entire; leaves glabrous above; stipuliform leaves about 2 cm. long. Style and stigma glabrous; calyx lobes glabrous within except on median line; corolla lobes glabrous within.....*C. citrina*
- Stigma bilobed, glandular-pilosulous; calyx lobes serrate or denticulate, strongly pubescent on both sides; bracts small (not over 5 mm. long) or absent; leaves equal at base, not auriculate or amplexicaul. Style glandular-pilosulous throughout; corolla lobes hairy within.
- Stems strigose; leaves glabrous above, strigose beneath, red over whole lower surface; filaments glabrous throughout; corolla yellow.....*C. rubra*
- Stems densely long-hirsute; leaves hirsute on both sides, not red or red-spotted beneath; filaments glandular toward base; corolla red.....*C. hirsutissima*

COLUMNEA silvarum Morton, sp. nov. Herba vel frutex, 0.6–3.6 m. altus; caules crassi, articulati, dense rubro-hispidi; folia per paria inaequalia, subsessilia, petiolo crasso, ca. 2 mm. longo; lamina foliorum majorum oblata, usque ad 16 cm. longa et 5.5 cm. lata, breviter et abrupte acuminata, basi valde inaequalis et obliqua, non auriculata, non amplexicaulis, herbacea, glanduloso-denticulata, non rubro-maculata, utrinque viridis, pilosula, subtus in venis hirsuta, venis lateralibus ca. 10-jugis, prominulis; folia minora stipuliformia, lanceolata, ca. 1 cm. longa, 4 mm. lata, acuminata, basi obliqua, viridia; inflorescentia axillaris, 2- vel 3-flora, bracteis basalibus lineari-subulatis, ca. 8 mm. longis, 1 mm. latis, integris,

pedicellis 1.5–2.5 cm. longis, gracilibus, dense rubro-hirsutis; calycis lobi lineari-subulati, subaequales, 2–2.5 cm. longi, ca. 3 mm. basi lati, longissime acuminati, remote laciniati (dentibus subulatis, ca. 2 mm. longis, ca. 3 utroque latere), utrinque rubro-hirsuti; corolla lutea (lobis basi purpureis), in calyce erecta, 4–4.5 cm. longa, basi subcalcarata (3 mm.), tubo supra basim contracto et 4 mm. diam., tubuloso, sursum ampliato et paullo ventricosus, 1 cm. diam., fauce contracto et 7 mm. lato, externe parce piloso, intus basi pilosulo, limbo subregulari, non bilabiato, ca. 1 cm. lato, lobis patentibus, suborbiculatis, ca. 3 mm. longis, rotundatis, 2 superioribus altius connatis, intus glabris; filamenta basi in tubum 5 mm. longum postice fissum connata, glabra; antherae exsertae, cohaerentes, quadratae, ca. 2 mm. longae et latae; ovarium sericeum; stylus glaber; stigma breviter bilobum, parce glanduloso-pilosulum; disci glandula postica solum evoluta, crassa, glabra, bidenticulata.—DARIEN: in rain forest on the crest of the Cana-Cuasi Trail, Chepigana District, alt. 1500 m., Mar. 15, 1940, *M. E. and R. A. Terry 1566* (Herb. Field Mus., no. 1,035,998, TYPE). A second specimen in the Field Museum was collected near the same locality at 600 meters elevation, Mar. 11, 1940, *Terry & Terry 1499*.

This species and *C. perpulchra* differ strongly from other Panama species of the section *Collandra* in their elongate corollas, about twice as long as the calyces. In the other species the corolla is included in the calyx or is only very slightly exserted.

DRYMONIA ALLOPLECTOIDES Hanst. var. *vallicola* Morton, var. nov. A var. *typica* foliis minoribus, calycis lobis angustioribus, minus hirsutis, corolla minus obliqua, minus hirsuta, limbo minus obliquo differt.—COCLÉ: north rim of El Valle de Anton, near Cerro Turega, alt. 650–700 m., June 30, 1940, *R. E. Woodson & R. W. Schery 203* (U. S. Nat. Herb., no. 1,808,024, TYPE); same locality and date, *Woodson & Schery 162*.

The typical form of this species is confined to Costa Rica.

DRYMONIA brevipes Morton, sp. nov. Frutex epiphyticus, scandens, 3–5 m. longus, ramosus; rami teretes, glaberrimi, apicem versus ca. 4 mm. diam.; folia per paria paullo inaequalia, petiolata, petiolo foliorum majorum 1.5–2 cm. longo, glabro; lamina foliorum majorum anguste oblonda, 20–24 cm. longa, 4.7–6 cm. lata, acuminate, basi cuneata, aequalis, coriacea, integra, utrinque glaberrima, viridis, non rubro-maculata, venis lateralibus supra obscuris, sub-

tus elevatis; folia minora similia, sed ca. 9.5 cm. longa et 3 cm. lata; flores solitarii, axillares, brevipedunculati, pedunculo ca. 13 mm. longo, glabro, apice incrassato; calyx verisimiliter coloratus, valde obliquus, lobis 3, valde inaequalibus, lateralibus late ovatis, ca. 2.4 cm. longis, 2.2 cm. latis, apice bilobatis (ca. 4 mm.), lobo postico fere libero, multo minore, ovato-lanceolato, ca. 18 mm. longo, 12 mm. lato, obtuso, omnibus glaberrimis; corolla rosea, ca. 7 cm. longa, in calyce obliqua, basi obtuse calcarata (6 mm.), tubo supra basim 11 mm. lato, gradatim ampliato, non ventricosus, fauce ca. 13 mm. lato, utrinque glaberrimo, limbo subregulari, ca. 3.5 cm. lato, paullo obliquo, lobis patentibus, subaequalibus, suborbiculatis, ca. 13 mm. longis, rotundatis, subintegris, non fimbriatis; filamenta basi in tubum 9 mm. longum crassum postice fissum connata, glabra, contorta; antherae connatae, inclusae, oblongae, ca. 6.5 mm. longae, 2 mm. latae; ovarium parce strigillosum; stylus glaber; stigma stomatomorphum; disci glandula postica solum evoluta, glabra, crassa, acuta.—COCLÉ: hills in vicinity of La Mesa, north of El Valle de Anton, alt. 1000 m., Jan. 21, 1941, *Paul H. Allen 2330* (U. S. Nat. Herb., no. 1,806,119, TYPE).

Evidently a rather close relative of *Drymonia conchocalyx* Hanst. of Costa Rica, but with a quite different calyx. In *D. conchocalyx* the calyx is obviously 5-lobed, the 2 anterior lobes being connate high up. In *D. brevipes* the calyx is apparently 3-lobed, the 2 anterior lobes being only slightly connate, but each anterior lobe is almost wholly connate with a lateral lobe. In both species the posterior lobe is nearly free and much smaller than the others. *Drymonia brevipes* may be distinguished also by the very short, thick peduncles.

DRYMONIA LANCEOLATA (Hanst.) Morton, Field Mus. Publ. Bot. 18: 1173. 1938.—In the 'Flora of Costa Rica,' I reported this species from Panama, but I do not now know on what basis. A definite record is: CHIRIQUÍ: Quebrada Velo, alt. 1800 m., July 8, 1940, *Woodson & Schery 268*.

DRYMONIA PARVIFLORA Hanst. *Linnaea* 34: 352. 1865-66.—CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 12, 1940, *Woodson & Schery 566*.

This distinctive species, which has the general appearance of the genus *Tussacia*, was originally collected at Candelaria, Costa Rica, by Hoffmann, and has since been known only from the type. The

specimen recently collected agrees perfectly with Hanstein's description.

DRYMONIA parvifolia Morton, sp. nov. Frutex parvus, epiphyticus; caules ca. 30 cm. longi, sulcati, glabri, apice ca. 4 mm. diam.; folia per paria aequalia, petiolata, petiolo 7–12 mm. longo, glabro, gracili; lamina foliorum lanceolata, 4–5.5 cm. longa, 1.3–2 cm. lata, obtuse acuminata, basi aequalis, cuneata, integra, papyracea, utrinque glaberrima, venis lateralibus 4-vel 5-jugis, subtus vix elevatis; inflorescentia axillaris, uniflora, bracteis nullis, pedunculo ca. 9 mm. longo, glabro; calyx irregularis, lobis liberis, 2 anticis anguste oblongis, 11 mm. longis et 3 mm. latis, obtusis, 2 lateralibus ovato-lanceolatis, 13 mm. longis et 5 mm. latis, acutis, postico ovato-lanceolato, 8 mm. longo et 3 mm. lato, acuto, omnibus integris, glaberrimis; corolla alba, ca. 2.5 cm. longa, in calyce horizontalis, basi postice calcarata (1.5 mm.), tubo basi ca. 3 mm. lato, sursum ampliato et in fauce non contracto, ca. 1 cm. diam., externe glabro, limbo terminali, subbilabiato, lobis magnis, externe pilosis, laceratodentatis; filamenta glabra; antherae cohaerentes, inclusae, oblongae, sagittatae, ca. 3 mm. longae; ovarium apice sericeum; stylus glaber; disci glandula postica solum evoluta, bidenticulata, glabra, crassa.—CHIRIQUÍ: trail from San Felix to Cerro Flor, alt. 100–850 m., Aug. 13–14, 1939, *Paul H. Allen 1949* (Herb. Missouri Bot. Gard., TYPE).

This species is another of those intermediate between *Drymonia* and *Alloplectus* sect. *Erythranthus*. It is not closely related to any other species, being distinguished by its entirely glabrous stems, leaves and calyces, very small and strongly unequal calyx lobes, and white corollas.

DRYMONIA rosea Morton, sp. nov. Planta epiphytica, erecta; caules ca. 30 cm. longi, subtetragoni, crassi, ca. 1 cm. diam., vix strigillosi; folia per paria subaequalia, breviter petiolata, petiolo crasso, vix 1 cm. longo, dense rubro-sericeo; lamina foliorum oblique ovata vel oblonga, subfalcata, usque ad 22 cm. longa et 8.5 cm. lata, acuta, basi obliqua, rotundata, subchartacea, apicem versus serrulata, supra viridis, scabro-strigillosa, subtus ubique rosea, praecipue in venis strigillosa, venis lateralibus 8–10-jugis, venulis ultimis subtus valde prominulis, reticulatis; inflorescentia axillaris, uniflora, bracteis minutis, subulatis, pedicello ca. 7 mm. longo; calyx viridis, lobis inaequalibus, acutis, anterioribus et lateralibus oblongis, 2.5–2.8 cm. longis, 1 cm. latis, postico ovato, 2.2 cm. longo et

12 mm. lato, omnibus acriter dentatis (dentibus subulatis, ca. 1 mm. longis, ca. 8 utroque latere), utrinque strigillosis, pilis minutis, rubris, glanduliferis; corolla lutea, in calyce valde obliqua, basi postice calcarata (2 mm.), tubo ca. 3.2 cm. longo, supra basim ca. 5 mm. diam., sursum ampliato, non ventricosus, in fauce non contracto, ca. 13 mm. lato, externe rubro-pilosulo, intus basi dense glanduloso-pilosulo, limbo obliquo, paullo bilabiato, lobo antico majore, ca. 9 mm. longo et 10 mm. lato, lobis lateralibus ca. 9 mm. longis et 7 mm. latis, lobis posticis ca. 5 mm. longis et 10 mm. latis, omnibus breviter fimbriato-dentatis (dentibus ca. 0.5 mm. longis), intus glabris; filamenta basi in tubum 7 mm. longum postice fissum connata, glabra, vix contorta; antherae liberae, inclusae, oblanceolatae, ca. 5 mm. longae, basi ca. 1 mm. latae, apice ca. 2 mm. latae, basi sagittatae, basi solum dehiscentes; ovarium sericeum; stylus dense pilosulus, brevis, crassus; stigma stomatomorphum; disci glandula postica solum evoluta, magna, crassa, glabra, paullo emarginata.—COCLÉ: vicinity of La Mesa, hills north of El Valle de Anton, alt. 1000 m., May 11, 1941, *Paul H. Allen 2489* (U. S. Nat. Herb., nos. 1,808,619–20, TYPE).

Perhaps related to *D. marmorata* Hook. and *D. turrialbae* Hanst., which also have leaves deep rose color beneath, but in these species the calyx lobes are entire or inconspicuously and irregularly crenulate; in *D. rosea* the calyx lobes are sharply and deeply subulate-toothed. In *D. rosea* the ultimate veinlets are elevated and very prominent beneath, giving a reticulation suggesting that of some genus of Rubiaceae such as *Sommeria*. I have never seen any similar venation in the Gesneriaceae.

DRYMONIA TURRIALBAE Hanst. *Linnaea* 34: 359. 1865–66.—In the 'Flora of Costa Rica' I reported this from Panama. The record on which this was based is *Pittier 5671* from Cerro de Garagará, Sambú Basin, Darien, alt. 500–974 m., Feb. 7, 1912. I have also examined another specimen in the Field Museum, *Terry & Terry 1421*, collected on the Cana-Cuasi Trail, Chepigana District, Darien, alt. 1200 m., Mar. 9, 1940. Neither of these collections has flowers in good condition for study, so it is possible that this Darien plant is different from the Costa Rican species.

GLOXINIA PALLIDIFLORA Hook.—CANAL ZONE: on large boulders in bed of waterfall, Government Forest Preserve, Madden Road, alt. 50 m., Nov. 29, 1940, *Paul H. Allen 2280*. Not previously collected wild in Panama.

MONOPYLE panamensis Morton, sp. nov. Herba terrestris; caules non ramosi, usque ad 70 cm. longi, puberuli; folia per paria inaequalia, longe petiolata, petiolo foliorum majorum usque ad 3.8 cm. longo, pilosulo; lamina foliorum majorum elliptica vel anguste elliptica, usque ad 20 cm. longa et 8.2 cm. lata, acuminata, basi valde obliqua, rotundata, tenuiter herbacea, grosse dentata, supra hirsutula, subtus puberula, venis lateralibus ca. 11-jugis, subtus prominulis; folia minora brevius petiolata, similia sed multo minora, ca. 4 cm. longa; inflorescentia terminalis, paniculata, 6-18 cm. longa, pedunculo communi 3.5-9 cm. longo, pilosulo, eglanduloso, apice bibracteato (bracteis subfoliaceis, viridibus, petiolatis), inflorescentiae ramis primariis brevissimis, usque ad 7 mm. longis, apice bibracteolatis (bracteolis subulatis, flavo-pilosulis), pedicellis 2-4, terminalibus, subumbellatis, inaequalibus, 2-22 mm. longis; calycis tubus cylindricus, ad anthesin ca. 5 mm. longus et 2 mm. latus, basi vix curvatus, ubique dense glanduloso-pilosulus; calycis lobi virides, oblongi, ca. 5 mm. longi et 1.5 mm. lati, obtusi, integri, crassi, externe pilosuli, intus apicem versus pilosuli, non recurvati; corolla basi alba, sursum caerulea, 1.2-1.6 cm. longa, late campanulata, in calyce obliqua, basi ecalcarata, non gibbosa, tubo basi ca. 4 mm. diam., sursum 11-13 mm. diam., externe pilosulo, intus glabro, limbo subregulari, ca. 1.7 cm. diam., lobis latis, rotundatis, intus glabris; filamenta libera, glabra; antherae cohaerentes, inclusae, ca. 1.5 mm. longae, loculis discretis, subdivergentibus; ovarium fere omnino inferum, pars libera conica, pilosula; stylus glaber; stigma stomatomorphum, glabrum; discus nullus; fructus capsularis, ca. 1.5 cm. longus, 3 mm. latus.—PANAMÁ: Cerro Campana, alt. 1000 m., Apr. 21, 1941, *Paul H. Allen 2413* (U. S. Nat. Herb., no. 1,793,920, TYPE); same locality, July 1, 1939, *Allen 1871*.

Related to *Monopyle puberula* Morton, of Costa Rica and Guatemala, but differing as follows:

Leaves long-petiolate (1.5-3.8 cm.); inflorescence (rachis, pedicels and calyx tube)	
densely glandular-pilosulous; calyx and lobes hairy within; corolla 1.2-1.6 cm.	
long; stigma glabrous.....	<i>M. panamensis</i>
Leaves short-petiolate (about 5 mm.); inflorescence eglandular-pilosulous; calyx and	
lobes glabrous within; corolla 2-2.8 cm. long; stigma pilose.....	<i>M. puberula</i>

Monopyle Maxonii is related also, but differs as follows:

Inflorescence branches and pedicels glabrate; hairs of calyx tube with elongate,	
uncinate gland; calyx lobes red-purple, recurved at tip, glabrous within; lower	
leaf surface glabrous; corolla usually 2-3 cm. long; stigma pilose.....	<i>M. Maxonii</i>
Inflorescence branches densely pilosulous; hairs of calyx tube with small, capitate	
gland; calyx lobes green, not recurved, hairy within; lower leaf surface strigose-	
puberulous; corolla 1.2-1.6 cm. long; stigma glabrous.....	<i>M. panamensis</i>

